Background Paper

Future Directions in Agriculture and Information and Communication Technologies (ICTs) at USAID

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WINROCK INTERNATIONAL
Putting Ideas to Work

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ACRONYMS

ADB	Asian Development Bank
AED	Academy for Educational Development
AfDB	African Development Bank
AKIS/RD	Agricultural Knowledge and Information Systems for Rural Development
ARPAN	African Rural Policy Analysis Network
AWLAE/ELN	African Women Leaders in Agriculture and Environment/ Electronic Learning Network
CAB	Commonwealth Agricultural Bureau (now CAB International)
CBO	Community Based Organization
CGIAR	Consultative Group on International Agricultural Research
DOT-COM	Digital Opportunity through Technology and COMmunication
DVD	Digital Video Disk
EGAT/AFS	Economic Growth, Agriculture, and Trade / Agriculture and Food Security
FAO	Food and Agriculture Organization
GIS	Geographic Information System
GPS	Global Positioning System
HTML	Hyper Text Markup Language
ICT	Information and Communication Technology
IDB	Inter-American Development Bank (also IADB)
IM	Instant Messaging
ISP	Internet Service Provider
LEO	Low Earth Orbit satellite
M3DADI	Multispectral 3 Dimensional Aerial Digital Imagery
MP3	MPEG, layer 3
NGO	Non Governmental Organization
PDA	Personal Digital Assistant
PV	Photo Voltaic [energy]
RET	Renewable Energy Technology
RIO	Reusable Information Object
SIP	Spatial Information Package
SMEs	Small and Medium Enterprises
SMS	Short Message Service
UNEP	United Nations Environmental Program
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations Children Fund
UNIFEM	United Nations Development Fund for Women
USAID	United States Agency for International Development
VITA	Volunteers in Technical Assistance
VSAT	Very Small Aperture Terminal satellite signal
WI	Winrock International
WID	Women in Development
XML	eXtensible Markup Language

EXECUTIVE BRIEF

There is scarcely a field of human activity today that has not been touched by the dramatic changes in Information and Communication Technologies (ICTs) taking place over the last 10-15 years. Agriculture and its associated natural resources management are no exceptions. This report examines the impact that new ICTs have had in agriculture, outlines trends and emerging ICT opportunities in the field, and offers some guidance on how the United States Agency for International Development (USAID) Agriculture and Food Security (AFS) division can build on its considerable experience to take advantage of ICTs effectively in development assistance.

ICTs have a role in each of the key strategies outlined in USAID's "Future Directions in Agriculture" document. ICTs can help *mobilize science and technology for agriculture* by linking agricultural specialists into virtual communities and accelerating agricultural research exchange between developing and developed countries. They can help *develop trade opportunities for farmers* by linking smallholders into increasingly globalized production chains. ICTs can *bridge the knowledge divide* by permitting geographically distributed organizations to work together more effectively, allowing them to provide mutual mentorship and support. Finally, ICTs can support *taking the long-term view*, with tools for understanding and planning the future effects of today's economic and land use decisions.

Understanding the place of ICTs in developing country agriculture depends on four key concepts: that **knowledge is an increasingly significant factor of production**; that all actors in the agricultural sector are part of **an evolving Agricultural Knowledge System** (AKS); that ICTs accelerate agricultural development by **facilitating knowledge management** for AKS members; and that ICTs are essential **coordinating mechanisms in global trade**. Expanding the use of ICTs in developing country agriculture will demand a more active and empowered role for rural intermediate organizations. These organizations will increasingly act as local knowledge brokers: they will identify client needs and suitable knowledge management methods, and provide feedback on the quality of existing agricultural knowledge services as well as identify new ones.

Effective ICT applications in the rural developing world face significant hurdles, especially in access provision for off-grid or remote areas. Rural telecenters have a poor sustainability record, but they remain critical tools and have potential for future improvement. Alternative models of connectivity ready for pilots utilize shared and inexpensive cell phones, pagers, DVDs, and personal digital assistants, combined with CD-ROMs or server-side Internet processing models. Sustainability needs to consider dimensions other than the survival of telecenter organizations: digital content, ICT training and awareness, and demand for ICT services may continue even where specific telecenters fail, and emerging technologies may start to address those needs.

USAID peer organizations such as the World Bank, FAO, Foundations, and other bilaterals are taking similar approaches to ICT opportunities – connectivity provision, capacity building for users, agricultural content development and aggregation, as well as conducive policy advocacy. The vast majority of ICT applications in agriculture are still in pilot stages and are distinguished more by the agricultural development themes they address than by the donor funding them.

Recommendations for Project Design in Agriculture and ICTs

- *Empower agricultural and rural intermediary organizations* such as extension agents, local NGOs, and producer associations through ICTs in order to increase their effectiveness at understanding and servicing their clients' needs.
- *Improve rural access to ICTs* through support of multi-use telecenters and piloting of emerging alternate technologies that foster inexpensive, low-power alternatives to PCs.
- *Develop and adapt relevant agricultural content for digital dissemination,* using local intermediate organizations to evaluate the relevance and technical accessibility of information from institutionalized sources or created by intermediaries themselves.
- *Ensure that women and girls can participate effectively* and equitably in emerging knowledge networks by ensuring women's access to ICTs, availability of women-oriented content (e.g., subsistence as well as cash crop information), and selection of intermediaries with women in meaningful positions as key partners.
- *Use ICTs to strengthen community feedback mechanisms* for democratic governance, research and extension feedback, and project impact assessment.

Recommendations for Increasing EGAT/AFS Capacity to Support Missions in ICT

- *Support development of region- and country-specific ICT strategy documents* in conjunction with regional bureaus and missions.
- *Provide an annual report to missions on key ICT uses in agriculture* in order to disseminate emerging uses and best practices of rapidly evolving technologies.
- *Develop an agency-wide rapid rural ICT assessment and evaluation methodology* to assist missions in identifying ICT opportunities and evaluate impacts.
- *Identify local or regional teams of rapid mobilization ICT-agriculture specialists* so that missions will have easy access to the technical skills necessary for ICT planning and use in projects.

Recommended Pilots and Continuations of Current Work

- *Mobilizing Science and Technology for Agriculture*: Partner with FAO and CGIAR groups to ensure that agricultural science and technology can be translated into media and language (including technical language) accessible to rural groups and intermediaries. USAID can add value by using its contributions to ensure that community feedback is taken seriously.
- *Developing Trade Opportunities for Farmers*: Sponsor vertical commodity portals and wired marketplaces to facilitate farming inputs and market opportunities, including technical support to improve smallholder bargaining power in contract farming.
- *Bridging the Knowledge Divide*: Pilot new models of distributed technical assistance and small farmer support services to compensate for declines in extension support worldwide.
- *Taking the Long-Term View*: Continue support to USAID's application of geospatial technologies in community and natural resource planning, including USAID's outreach and education efforts.

CHAPTER I
THE IMPACT OF NEW ICTS ON AGRICULTURE

There is scarcely a field of human activity today that has not been touched by the dramatic changes in Information and Communication Technologies (ICTs) that have taken place in the last 10-15 years. Agriculture and agriculture-related natural resource management are no exceptions. This white paper examines the impact of new ICTs on agriculture, outlines emerging opportunities, and offers some guidance on how the United States Agency for International Development (USAID) Agriculture and Food Security (AFS) division can build on its considerable experience to take advantage of ICTs in development assistance.

Information and the technologies that facilitate its use, exchange, and reliability have been important aspects of agriculture and agriculture-related natural resource management for centuries.[1] Decisions on what to plant, when to plant it, how to cultivate and harvest, and where to store and sell and at what price have long depended on knowledge, communication, and information exchange. The importance of information and communication technologies to agriculture is not new, and many traditional methods of managing and communicating information will continue to be critical to developing country agriculture. Some recent ICTs *are* offering new opportunities, however, to increase the timeliness and availability of critical information, improve its quality and relevance, and offer more cost-effective methods for empowering and ensuring feedback from previously marginalized communities. In addition, the emergence of global agricultural production chains interlinked by digital networks has important implications for the livelihoods of those presently outside of the system.

A. Defining ICTs and the Significance of the Digital Revolution

USAID's draft ICT for Development Strategic Plan defines information and communication technology as the combination of hardware, software, and the means of production that enable the exchange, processing, and management of information and knowledge.[2] ICTs thus include technologies and methods for storing, managing, and processing information (e.g., computers, software, books, PDAs, digital and non-digital libraries) and for communicating information (e.g., mail and email, radio and television, telephones, cell phones, pagers, instant messaging, "the web," etc.).

In everyday speech, ICTs commonly refer to electronic and digital devices and the software used for storing, retrieving, and communicating information. However, the poorest and most vulnerable populations with whom USAID works may have little opportunity or capacity to use or benefit from ICTs so narrowly defined. Broadening the definition to include some older,

[1] In this document, "agriculture" is taken to mean both the traditional activities of agriculture (e.g., planting, harvesting, marketing, animal husbandry) and the natural resource management activities associated with agricultural work (e.g., water management, soil fertility, agroforestry, fishery management).
[2] This definition is taken from the September 2002 draft of USAID's ICT for Development Strategic Plan.

more traditional technologies and methods (e.g., accounting ledgers, couriers, radio, television, face-to-face training) allows the discussion to focus on the needs of agricultural communities and applicability of new technologies while simultaneously including more technologies available to the rural poor.

1. The digital revolution and digital ICTs

The renewed interest in ICTs for development arises because of the opportunities that *digital technologies*[3] enable. The ability to record text, drawings, photographs, audio, video, process descriptions, and other information in digital formats means that exact duplicates of such information are possible at significantly lower cost than before. Moreover, digital and analog communications networks such as telephones and the Internet can transfer that information rapidly over large distances – around the globe if necessary. In many cases, the ability to transfer information via telecommunications networks can increase the value of producing information, lower the cost of delivering it to audiences, and improve the capacity of remote communities to review the quality of services they receive.

If information is time-sensitive, the increased delivery speed possible through digital communications networks can raise its value tremendously. With information duplicable and globally transferable at low cost, information in digital form can be drawn from countless sources – local and remote – and repackaged to suit a user's needs. Digital ICTs can thus be more *interactive* than their non-digital counterparts – they can respond more easily to a user's specific requirements, often through automated or artificially intelligent processes that allow for efficient use of limited human resources.

Capacities that digital ICTs can bring to their users

- Storage of text, graphic, photographic, audio, video, and other information as digital files
- Exact or near-exact duplication of digital information at low production cost
- Rapid (sometimes instantaneous) transfer of digital information over long distances
- Ability to apply standardized algorithms to large quantities of information relatively rapidly
- Greater interactivity in communicating, evaluating, and producing useful information.

2. Continuing importance for non-digital ICTs

This paper concentrates on the trends, applications, and uses of digital ICTs in agriculture because they are newer and may be less familiar to readers. Nonetheless, traditional or non-digital ICTs[4] continue to be important. In many situations, USAID's clients have greater access to or familiarity with non-digital ICTs (e.g., radio) than digital ICTs, to which access may be entirely lacking. These constraints, although they can be overstated, represent significant

[3] Digital technologies are those in which information is stored or processed in forms of 0's and 1's. Their main advantage is that perfect or near perfect copies can be made, dramatically improving the quality of information retrieval and exchange, and increasing the usefulness of the information stored.

[4] Non-digital ICTs include items such as radio and television, telephones, manual accounting systems, and other methods which do not involve digital storage and transmission.

challenges to the effective deployment of digital ICTs for agriculture in areas where USAID works.

Traditional or non-digital ICTs continue to be important and demand particular attention in three cases:

- When the present use of non-digital ICTs indicates ways in which digital ICTs could add value, cut costs, improve quality, or scale up the benefits of an activity
- When the use of non-digital ICTs offers a baseline to compare costs vis-à-vis a digital approach
- When a smooth interchange between the digital and non-digital world is important, so that the information USAID's clients need and supply can travel across the digital/non-digital boundary (e.g., rural radio, information pamphlets)

B. ICTs in Developed and Developing Country Agriculture

Information and communication technologies are rapidly transforming the face of agriculture in industrialized countries. Many if not most activities in the agricultural marketplace are now mediated by web-linked databases specifying prices, qualities, and quantities demanded. Electronic communication and websites enable farmers to access credit, government programs, and technical assistance under a variety of finance modes. Livestock semen, transgenic crops, and business development services can be located, bought, and paid for over the Internet, often delivered by next-day courier. Access to knowledge and information in many forms has become a key element of agricultural competitiveness at household, regional, and international levels. Information about agricultural products themselves and the conditions under which they are produced account for an increasing proportion of the final price, as demonstrated by the premiums attached to organic and fair-trade products. In short, the face of developed agriculture has changed as ICTs have become increasingly critical to farmers and agricultural planners in the developed world. In economic terms, information has become so critical that it needs to be recognized explicitly as a fourth production factor in agriculture.[5]

The transformation of agriculture in developed countries has taken place in a context of high literacy rates, well-functioning telecommunication systems, readily available electricity, an established and regulated credit and banking system, well-developed transportation networks, high labor costs relative to the cost of computing equipment, and reasonably easy access to ICTs. In many areas where USAID seeks to have an impact, only some – if any – of these conditions may apply. Some might argue that these limitations make investment in ICTs for agricultural development too costly to be useful for genuine poverty alleviation or economic growth in rural communities.

[5] The traditional three factors of production are land, labor, and capital. Information has always been a fourth important factor, but the increasing intensity of information in developed country agriculture has made correct and timely information about customer needs, production techniques, and quality standards a key determinant of price, profitability, and sustainability.

In fact, *not including* ICT or ICT-enhancements in USAID's agriculture programs has serious costs and negative consequences. Farming families or communities that cannot connect to global information networks will not be able to take advantage of the opportunities they offer to reach higher-value regional and global markets. Aside from the lost development impact, such isolated communities will likely resent the effects of globalization and may associate them – as some do – with the policies of the United States, adding fuel to international security concerns. Furthermore, integrating ICTs into projects may help improve the performance of USAID-funded agricultural development efforts. One of the advantages of digital information and communication technology networks is that information can flow quickly in many directions. This means that ICTs can lower barriers to community feedback and empowerment, as well as provide central managers with tools to better monitor project progress and assess community needs.

C. The Importance of Agriculture to Development and the Contribution of ICTs

In most developing countries, the agricultural sector is the largest and most critical economic sector. More than half of the developing world's population lives in rural areas and is economically dependent on the performance of agricultural production. Agriculture provides food, is generally the largest market for labor, provides tradable goods – hence foreign exchange – for the national economy, and contributes to government budgets through taxation. A weak agricultural economy producing insufficient food is frequently associated with weak or nonexistent democracy and may lead to migration, civil unrest, an unhealthy and unproductive labor force, and mismanagement or abuse of environmental resources.

Women are the majority of the world's food producers. Worldwide, women produce more than half the food, and in some regions such as sub-Saharan Africa, they grow as much as 80% of the food crops. Universally, women are also responsible for preparing food for the family, and thus for the nutritional quality of food for their children. As primary caretakers women also have the greatest influence on the level of education and training that children in rural areas receive.

Society and the development community are confronted with the enormous task of stimulating growth in rural areas where 75% of the poor (90% in Africa) reside, while meeting the food needs of a growing world population without intensifying environmental degradation, social inequity, or adverse consequences for human health. These challenges require more than increased financial resources, which are also important – they require the development and dissemination of locally appropriate agricultural innovations, many of which may be discovered and refined in developing countries. ICTs are the highways that can facilitate the trade and exchange of innovations to address these pressing agricultural challenges.

Historically, technology improvements have had great impact on increasing food crop production and lowering food prices. Information and communication technologies have reduced the cost and increased the spread of communication, reduced previous barriers of time and location, and accelerated the integration of national production and finance systems into global systems. They

are key catalysts in the present and largely unstoppable process of globalization. At the same time, there is increased concern that countries and national economies that are unable to compete effectively on the world market are becoming marginalized in the global systems that ICTs enable, widening the gap between wealth and poverty.

Long-term improvements in living standards for the rural poor require both resources and innovations to facilitate access to new markets and improve production capacity. ICTs have important roles in each of these areas. Improving agricultural performance is also a prerequisite for economic growth and creation of a stable environment for democracy. In poor countries, even a modest growth in agricultural output can significantly affect the national economy, and advances in agricultural science and technology have historically played pivotal roles in alleviating hunger and poverty. Agricultural innovation is understood today to be the result of an interacting constellation of agricultural actors: not just public agencies such as the extension network, but also private firms, NGOs, farmer associations, and others. In this context, ICTs are more than simply a tool to make each entity individually more productive; ICTs offer methods for weaving agricultural actors together into networks that can collectively identify, modify, act on, and implement relevant innovations.

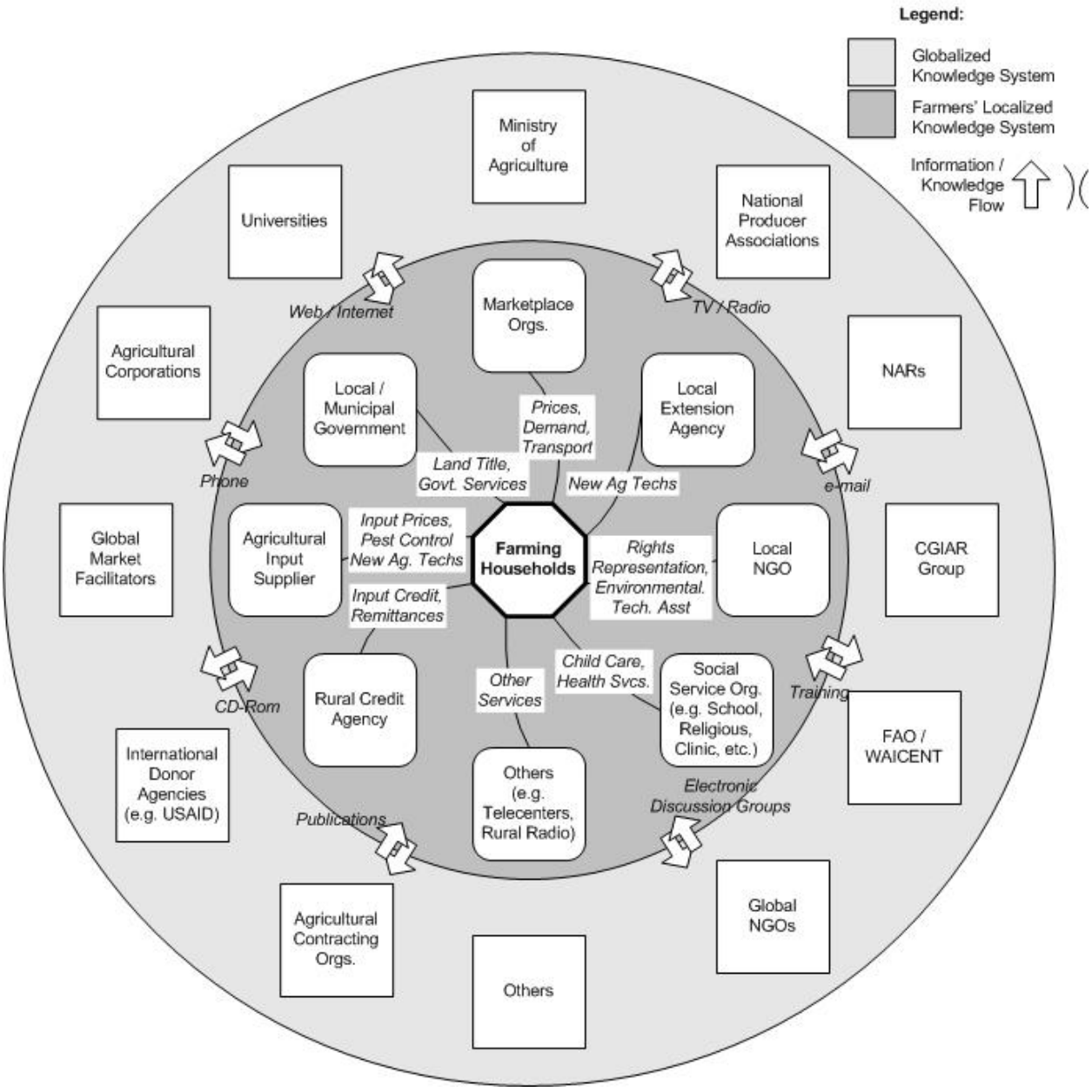
D. ICTs, Critical Information Flows, and the Agricultural Knowledge System

The variety of new ICT tools for agriculture is impressive, but the tools need to be placed in an overall context of agricultural information and communication needs. By looking at the critical information needs of agriculture and farming communities, the focus can move away from a compendium of "neat gadgets" and their individual applications toward understanding of their overall role in promoting productive, equitable, and sustainable agriculture. The key framework for this is the *Agricultural Knowledge System* (AKS), consisting of the organizations, sources of knowledge, methods of communication, and behaviors surrounding an agricultural process. Knowledge is not the same as information: knowledge includes information, understanding, insights, and other information that has been processed by individuals through learning and thought. For USAID, the AKS approach is centered on meeting the needs of small farming households.

Figure 1.1 offers an illustration of the AKS surrounding a typical smallholder household. As farmers make critical decisions throughout the year (e.g., credit applications, crop selection, tillage methods, pest control, harvesting, post-processing, marketing), a typical household will rely on its own accumulated experience and the support of local organizations (e.g., producer associations, input suppliers, rural credit agencies, extension services, NGOs, schools and others). The household may also receive radio and television broadcasts from more distant sources. Together, these form the local knowledge system accessible to a small farmer (signified by the inner circle in figure 1.1). The localized knowledge system represents information sources that are relatively accessible to a farming family and generally include an understanding of the farmer's specific context and needs through repeated and often reciprocal interactions. Often there is a higher degree of trust between farmers and the entities in their local AKS than between farmers and more distant entities, such as national ministries or global organizations.

Figure 1.1

Globalized and Localized Agricultural Knowledge Systems
Surrounding a Typical Farming Household



Information exchange in the local knowledge system is generally by non-digital means: face-to-face discussions, printed pamphlets, videocassettes, radio broadcasts, etc.. Local communities may lack affordable power and communication systems to drive ICTs, or they may need investments in human capacity to maintain them. Increasingly, some communities will begin to

have access through such services as cellular phones, rural use of battery or solar-powered personal digital assistants (PDAs) or local telecenters/cybercafés run out of local organizations.

The farmer's local AKS is connected to a more globalized AKS, depending on the speed and degree to which needed information can pass between the two. The global knowledge system consists of national and international organizations in agriculture and rural development such as ministries, the CGIAR group, and NGOs (lighter, outer circle in figure 1.1). These institutionalized knowledge sources typically have technical, policy, and market information that smallholders may not be able to access directly because of distance, expense, or literacy constraints, or because material is in another language or at pitched at an overly technical or academic level. Today, many institutions in the global knowledge system already have basic connectivity to the Internet, websites, and other digital media, and many use ICTs to partner and coordinate their activities and research. Several, such as the CGIAR group, global NGOs, the World Bank, and agricultural ministries are setting up Internet websites to deliver services to each other and more local organizations. Many regional development banks, including the Asian Development Bank and the World Bank, are also supporting government efforts to build statistical and ICT-enabled information dissemination capacity within agriculture and other ministries.

FAO and AKIS/RD

Viewing the agricultural sector as a "knowledge system" fits well with the notion of AKIS/RD (Agricultural Knowledge and Information Systems for Rural Development [FAO & World Bank, 2000]). The concept of AKIS/RD attempts to identify all sources of knowledge and information in the agricultural sector. It explicitly includes indigenous knowledge and farmers' experience. It also includes the often-ignored private sector firms as relevant sources of knowledge and information. The AKIS/RD approach implies a central role for partnership and collaboration among stakeholders. The identification of stakeholders and partners is often the first step towards the establishment of a knowledge management network, which is a network of knowledge sources and knowledge seekers linked by efficient communication technologies. The implication of the knowledge system management concept for extension training is clear: flexibility, teamwork, client orientation, innovation, and communication are key attributes of successful employees in a knowledge management organization. It also implies a much more empowered role of the rural extension agent. She or he is no longer someone who simply passes on messages from above, but is now someone who has become a local "knowledge broker," actively sharing knowledge with stakeholders with the purpose of facilitating innovations that will benefit the community.

Agricultural knowledge and information needs to be managed like any other key business input. Advances in ICTs have helped create an entirely new discipline, termed *knowledge management*. Effective knowledge management means that an organization or network of partners gets the right information to the right person at the right time in a user-friendly and accessible manner so that they can perform their jobs efficiently.

Development efforts must improve the capacity of the agricultural knowledge system to manage and disseminate knowledge effectively, particularly to small farming families and women. ICTs can play an important role in linking knowledge seekers to knowledge sources. Agricultural research, extension, and development organizations – public or private, for-profit or non-for-profit – are all part of an overall agricultural knowledge system linked by information and

communication. These organizations are in the business of providing knowledge as a product or service.

A helpful approach, which USAID has already applied in some contexts, is to map out the information and communication needs of clients within their agricultural economic/social system and to help key elements in that system find information they need, when they need it, in accessible terms and language, and at prices that are realistic given available resources and USAID's sustainable development objectives. These objectives need to incorporate growth, equity, and environmental dimensions. From this starting point, an effective ICT strategy can take a *knowledge brokering* approach: identifying who needs information, who can supply the information, what formatting and delivery mechanism will allow the knowledge provider and consumer to communicate and share information, and what institutional/market structure will provide the appropriate incentives for such sharing to take place.

Knowledge Brokering Systems Planning for Agriculture

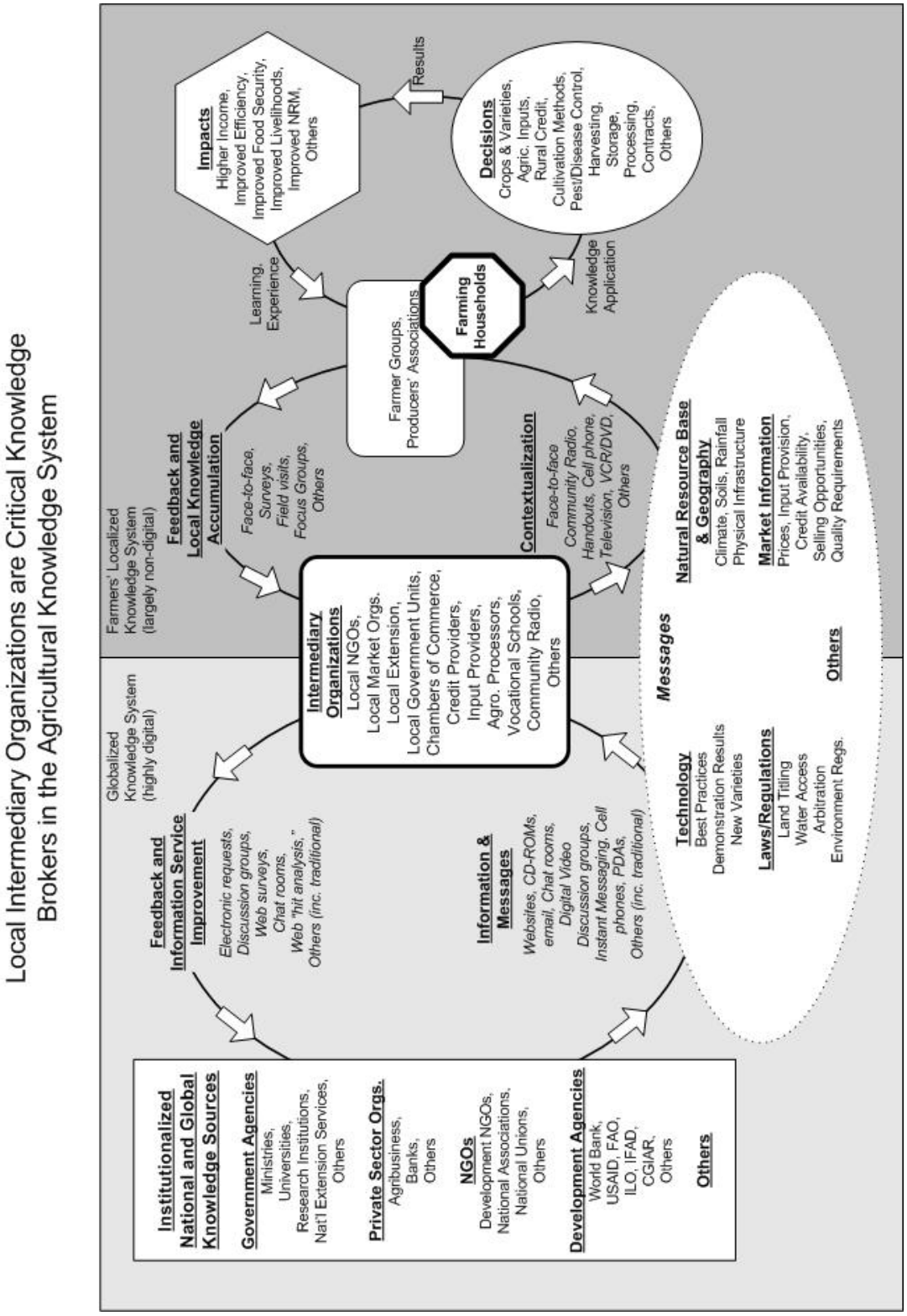
- Who needs what information and why
- Who has the needed information
- What packaging and delivery mode will allow the information provider and consumer to share information at the necessary time
- What institutional or market structure will provide the incentives for such sharing to take place

A successful USAID approach to ICTs in agriculture will focus on knowledge management and knowledge brokering techniques to ensure that the AKS will address the needs of small farmer households as it evolves. In some cases, this will mean connecting organizations in the local agricultural knowledge system to each other and to the global knowledge system. In others, it will involve forming partnerships with government agencies, local organizations, and the private sector to ensure that the knowledge and content in the global realm in fact meets the needs of local farmers. This approach has immediate applicability to three of the four legs of EGAT/AFS' new agriculture strategy: mobilizing science and technology for agriculture, building trade opportunities for farmers, and bridging the knowledge divide. By ensuring that the evolving agricultural knowledge system includes relevant natural resource management entities, it can also help promote long-term planning and taking the long-term view.

Figure 1.2 shows the AKS again, illustrating information flows from institutionalized knowledge sources to intermediaries to client users and vice versa. The key highlights of knowledge and information flows in 1.2 are:

- The importance of feedback loops and return information and communication flows
- The importance of intermediary organizations that can act on behalf of the client farming households to bridge digital and non-digital systems through ICTs
- The variety of organizations that are part of the system, linked together by ICTs to provide new sources that many intermediaries can tap to service their communities

Figure 1.2


Local Intermediary Organizations are Critical Knowledge Brokers in the Agricultural Knowledge System
Farmers' Localized Knowledge System (largely non-digital)
Globalized Knowledge System (highly digital)
Impacts
Higher Income, Improved Efficiency, Improved Food Security, Improved Livelihoods, Improved NRM, Others
Results
Decisions
Crops & Varieties, Agric. Inputs, Rural Credit, Cultivation Methods, Pest/Disease Control, Harvesting, Storage, Processing, Contracts, Others
Learning, Experience
Farmer Groups, Producers' Associations
Farming Households
Knowledge Application
Feedback and Local Knowledge Accumulation
Face-to-face, Surveys, Field visits, Focus Groups, Others
Contextualization
Face-to-face Community Radio, Handouts, Cell phone, Television, VCR/DVD, Others
Intermediary Organizations
Local NGOs, Local Market Orgs. Local Extension, Local Government Units, Chambers of Commerce, Credit Providers, Input Providers, Agro. Processors, Vocational Schools, Community Radio, Others
Messages
Natural Resource Base & Geography
Climate, Soils, Rainfall
Physical Infrastructure
Market Information
Prices, Input Provision, Credit Availability, Selling Opportunities, Quality Requirements
Technology
Best Practices
Demonstration Results
New Varieties
Laws/Regulations
Land Titling
Water Access
Arbitration
Environment Regs.
Others
Feedback and Information Service Improvement
Electronic requests, Discussion groups, Web surveys, Chat rooms, Web "hit analysis," Others (inc. traditional)
Information & Messages
Websites, CD-ROMs, email, Chat rooms, Digital Video Discussion groups, Instant Messaging, Cell phones, PDAs, Others (inc. traditional)
Institutionalized National and Global Knowledge Sources
Government Agencies
Ministries, Universities, Research Institutions, Nat'l Extension Services, Others
Private Sector Orgs.
Agribusiness, Banks, Others
NGOs
Development NGOs, National Associations, National Unions, Others
Development Agencies
World Bank, USAID, FAO, ILO, IFAD, CGIAR, Others
Others

1. Feedback and "Return Flows:" beyond information broadcasts

Disseminating important agricultural information to farmers has been an integral part of agricultural development strategies for years. In an ICT-enabled approach, information dissemination from institutionalized knowledge sources will continue to be important, but the real transformation that ICTs make possible is to allow feedback and "return flows" of information from users that tell information suppliers whether the information they supply is useful or relevant and offer guidelines to improve it. Promoting knowledge feedback from rural communities does not necessarily require a connection to the Internet; paper surveys, mailed floppy disks, telephone voice menus, PDAs, and other methods are also options.

Information and communication technologies can promote feedback in the AKS by:

- Facilitating two-way transmission of data and knowledge from local to global knowledge centers (e.g., Internet connections, cell phones, floppy disks, mobile storage devices, PDAs, digital cameras)
- Providing methods for central agencies to capture and analyze large quantities of feedback or requests from distributed field sites (e.g., databases, telephone call logs, web surveys, statistical analysis, website "hit analysis," weblogs, discussion groups, automated decision trees, artificial intelligence)
- Reducing the effort involved in producing new information and knowledge that responds to feedback (e.g., lower creation costs vis-à-vis print materials, fewer if any print runs required, distribution more easily targeted, techniques for distributed research)
- Linking remote users into mutual support networks so that they can both provide and benefit from their own accumulated experience and expertise (e.g., discussion groups, some commodity portals, electronic networks such as AWLAE/ELN[6])

The feedback that ICTs enable has the capacity to facilitate continuous improvements in the quality of local AKS services and to empower communities, but *programs must include explicit plans to take advantage of feedback potentials*: they do not happen automatically just because a digital technology is used. Processes must be designed and people given specific responsibilities to analyze and respond to feedback in order to take advantage of the opportunity. Presently many information sources use ICTs to make information available. Few if any provide client-friendly opportunities to provide feedback on the content of the information posted.

Examples of "return flows" of information include evaluations on the applicability of good practices advocated via the Internet or local price and market information supplied from remote/distributed sources, aggregated at a central location. In such cases, it is important to ensure that local communities have the capacity and opportunity to produce and publish their own content, and that they have some control over the information they divulge about themselves. ICTs may also offer opportunities for users to sell information about themselves if it is valuable, presenting an additional revenue opportunity for smallholders and their

[6] AWLAE/ELN is the African Women's Leaders in Agriculture and the Environment's (AWLAE) Electronic Learning Network (ELN).

organizations. The diversity of ICT delivery mechanisms and the capacity of Internet-connected servers to repackage digital information to other devices can assist in overcoming many obstacles to cost-effective rural feedback promotion.

Information choice and *sources diversity* are key to making feedback real and meaningful. Figure 1.1 shows more than how knowledge flows back and forth between local and global systems; it also emphasizes that a farming household should have several sources for the information they need to make key decisions, as well as their own knowledge and accumulated experiences. For example, rural credit may come from a traditional rural credit association, but a local input provider may also have special credit terms that larger suppliers make available, or organizations that contract small farmers and their associations may offer both credit services and technical assistance in a bundled contract to help communities meet yield and quality standards. Empowerment ultimately comes from a farmer's ability to exercise choices among meaningful options. Connecting one organization to global knowledge networks is not sufficient; it is essential to promote a diversity of quality information services that a community can choose among and access.[7]

2. Rural intermediate organizations become critical knowledge brokers

The presence of ICTs that facilitate choice and feedback will change the role of local intermediate organizations such as NGOs, extension workers, producers' associations, and input providers that work closely with farming families. For many regions, particularly in parts of Africa, direct use of ICTs by farmers – with the exception of the cell phone – may take decades. On the other hand, local intermediary organizations are significantly more likely to have the organizational capacity, human capacity, and access to the necessary infrastructure to take advantage of ICTs to deliver needed services to the rural poor. Their role will increasingly change from disseminating information sent to them by official knowledge sources (see fig 1.2) to acting as *knowledge brokers* that comb various sources to help clients find the information and resources they need and place that information in a local context.[8]

In figure 1.2 intermediary organizations are the lynchpin of a well functioning agricultural knowledge system, straddling the dividing line between the digital, globalized knowledge and trading system interlinked by digital ICTs and the community's local system, which will often rely on non-digital ICTs. Figure 1.2 highlights four different functions that intermediaries must master to make the system function well. Effective intermediate organizations must have capacity to:

[7] In the case of hardware provisions, arrangements in which multiple organizations and services can share access to a single set of equipment may be necessary; the critical point is that USAID funded work should ensure that the hosting organization share that access with other potentially competing groups.

[8] The idea that intermediate organizations and knowledge sources should permit feedback is not entirely new. In practice, however, feedback has been difficult and costly to implement, and is frequently forgotten as projects mature (in part because of the risk of negative feedback affecting project publicity). ICTs do not guarantee a solution to all of these problems, but they do offer techniques for reducing the effort feedback requires and increasing the capacity to respond to feedback.

- Know about and *search global knowledge sources and their own experience* for answers to pressing farmer needs. This includes searching digital sources via ICTs, but not excluding traditional and non-digital sources.
- *Contextualize global knowledge* so that it applies to the realities of the local community. This may involve a translation of material into less technical language, the addition of information about local conditions (e.g., soil types, market conditions)
- Pro-actively *assess and articulate present and future information needs* of clients, including *feedback on the availability of and usefulness of locally accessible knowledge*.
- *Provide objective feedback to national and global knowledge sources*, which may include the *production of locally developed content on lessons learned*, preferably developed through participatory methods.

The role of the intermediate organization is that of a knowledge management organization whose purpose is to introduce change for the benefit of the clients. These organizations generally avoid issuing prescriptive recommendations; rather, they play an advisory and facilitating role. In short, intermediate organizations are organizations that provide management of information, communication, and knowledge that allow farmers and farmer groups to make better management decisions that will improve their long-term livelihoods.

The critical point is that these knowledge processes do not occur automatically. This is a new role for many support organizations and their staff. Intermediate organizations need training and support in problem diagnosis, problem solving, participatory decision-making, organizing, convening, and motivating – all attributes of a successful facilitator. Such training should include how to seek information via the Internet, how to take that information and modify it for their (farming) clients, how to interact with farming households and facilitate knowledge use, and how to follow-up, gather information regarding farms' experiences, and relay this back to the original information providers and institutionalized knowledge sources.

Some rural intermediary organizations that can benefit from ICT empowerment

Local Governments	Farmers' Unions/Associations	Agro-processors
Chambers of Commerce	Development NGOs	Agricultural Input Providers
Local Extension Services	Vocational Schools	Rural Credit Organizations
	Community Radio Stations	

Designing ICT-enabled knowledge flows between these actors in any specific case requires careful consideration of the types of ICTs accessible by each group and the technological and conceptual packaging of information so that it can flow effectively from one user to the other. Effective ICT deployment explicitly considers the appropriate interfaces between the digital and non-digital worlds, so that those without access to digital ICTs can still benefit from an improved local information environment. From the perspective of the smallholder farmer, the key question is how to gain access to information and resources. These farmers need local support groups that will act as brokers between the available knowledge system and the individual needs of farming households. Developing economical local access for the rural poor and ensuring appropriate content is the essence of bridging the digital divide.

3. Information that can or should be communicated through ICTs

ICTs can accelerate agricultural development by providing more accessible, complete, timely, or accurate information at the appropriate moment to those making key on-the-ground decisions. Examples of such decisions are: what and when to plant; where to locate agricultural inputs (and at the best price); how to identify and respond to disease, pests, and drought; where to sell products; what new technology options exist for production, post-harvest, and soil fertility control; what agricultural credit programs are available; and how to access relevant government programs, including land titling.

Digital ICTs can add value over traditional methods when:

- Information is time sensitive (e.g., prices)
- Information requires significant customization to satisfy a client's need (e.g., soils content, local policies)
- The information needed involves standardized calculations (e.g., credit evaluations)
- Knowledge requires significant back-and-forth interactivity over distances (e.g., locating a remote specialist for disease/pest diagnosis and treatment)

Figure 1.2 captures the typical sets of information and knowledge flows that are important to farming households as they make key agricultural decisions throughout the year. These include knowledge and information about agricultural technologies and methods; the local natural resource base and geography; the policy environment, laws, and regulations; and market information. Some examples appear in table 1.2.

Table 1.2: Samples of key information and messages exchanged within the agricultural knowledge system

Agricultural Technologies	**Natural Resource Base and Geography**
Best Practices	Climate and Weather
Demonstration Results	Soils Information
New Varieties	Rainfall and Water Sources
Technical Assistance	Physical Infrastructure (e.g., roads, irrigation, structures)
Policy Environment, Laws, and Regulations	**Market Information**
Land Titling	Prices, Quality Requirements
Labor Laws	Input Provision
Water Access Rights	Credit Availability
Arbitration and Dispute Settlement	Selling Options
Environmental Regulations	Labor Supply and Demand
Entrepreneurial Rules and Off-Farm Income Options	Distribution and Other Logistics
Others	
Communication with migrant family members, remittances, etc.	

International and national research centers do admirable jobs of making their research findings available. For example, CAB International has developed an impressive comprehensive set of data banks with exceedingly valuable information on species and care for forestry, farming, and

biodiversity. An important consideration is to ensure that such data banks are demand-driven and to verify whether the information is useful to the majority of farming households. Facilitating partnerships with intermediary organizations to test, vet, and refine these services is an area with high impact potential for USAID.

4. ICT enables USAID's clients to collaborate more effectively and equitably

ICTs can bring about transformation because they facilitate communication between and among previously disparate groups. As a result, many agricultural development projects can involve larger numbers of stakeholders acting on greater and more detailed information, and facilitate more responsive or democratic governance.[9] ICTs are able to improve stakeholder inclusiveness, implementation transparency, and accountability through:

- Declining transaction costs in the form of reduced communication costs (e.g., email, voice mail, instant messaging, voice mail)
- New ICT techniques to organize and manage participation from greater and more geographically dispersed sources (e.g., discussion boards, chat rooms, virtual collaborative environments, weblogs)

Several types of communities are candidates for improved ICT inclusion:

Virtual networks to support subject matter specialists. Strong and mutually accessible virtual communities for specialists are critical for the generation and dissemination of agricultural knowledge among key research and knowledge centers in developing and developed countries. They are also a potential resource that intermediaries can access to put that knowledge in the service of communities and family farmers. ICTs are clearly not the only condition enabling such exchanges, many of which predate the digital revolution, but they facilitate the process considerably through electronic discussion boards, listservers, email, and common websites. Good examples are found in the scientific communities. In USAID-sponsored Collaborative Research Support Programs (CRSPs), agricultural scientists extensively communicate with each other via email, bulletin boards, and virtual conferences.

Virtual communities are extremely useful in knowledge sharing and research dissemination among recognized specialists, national and international researchers, biotechnologists, and agricultural professionals. For experts and groups of specialists who may already possess some Internet connectivity, a helpful approach is to identify mechanisms and appropriate incentives to facilitate rapid research dissemination using ICTs, or to establish them in cases where they do not yet exist. From a technology standpoint, such a strategy might involve setting up digital library systems, listservers, and networks for research exchange, or identifying existing mechanisms and providing access to the appropriate persons. From the incentives standpoint,

[9] Although ICTs can help eliminate technical and financial barriers to greater participation, inclusion, and information exchange, it is important to recognize that some barriers are political or social in nature, and may continue despite the technical feasibility that ICTs enable. Distinguishing situations of technical from political exclusion up front will help make ICT deployment for greater inclusiveness more effective.

those specialists and experts must be able to see financial, professional, or other gains from contributing their knowledge to such a system.

The Consultative Group for International Agricultural Research (CGIAR) has devoted significant resources to linking its agricultural scientists and research centers into more effective virtual communities. CGIAR's Organizational Change program (www.orgchange.org) has emphasized knowledge management as a way (a) to keep a diverse set of research institutes interconnected and (b) to reduce costs through more effective communication and information sharing. Under the OrgChange umbrella, IFPRI in the United States has launched its Global Knowledge Sharing project, which explicitly seeks, among other objectives, to "establish a community of practice for [agricultural] information providers." CGIAR's InfoFinder (infofinder.cgiar.org) is a simply designed but effective engine that aggregates and sorts agricultural research publications from diverse libraries with commentary for CGIAR researchers to use.

Virtual networks that support layperson expertise. Subject matter specialists often have greater access to the social and technological infrastructure that can support electronic and non-electronic communities. However, the most locally applicable innovations are likely to emerge as ordinary laypersons and community intermediary organizations form their own virtual networks or communities and share their own knowledge and experience. In practice, an enormous share of smallholder technical assistance in developing countries – probably a majority – is accomplished by neighboring farmers asking each other how they have solved specific problems. ICTs located at producers' associations or similar entities can accelerate this process by effectively broadening a farmer's "neighborhood," tracking the most common sets of questions, and creating a library of responses, as well as providing a mechanism to identify key issues that small-farmer friendly agricultural research agendas should address.[10]

Providing ICT access to and building the capacity of agricultural cooperatives, small-scale businesses, women's groups, and trade associations – all examples of intermediary organizations – are ways to ensure that the increased availability of knowledge that ICTs facilitate can reach and benefit the most vulnerable and remote segments of the agricultural value chain. ICTs can enable or help scale new models of access and technical assistance, such as "knowledge stockists" – input suppliers who also provide access or act as intermediaries to ICT networks of knowledge. ICT availability could permit greater competitiveness in privatized technical assistance networks, keeping prices low for end users of the service. To be effective, vibrant virtual communities of any type frequently require a trusted facilitator or moderator with a stake in keeping the community active and valuable for its members.

Mentor networks and field-research linkages. Virtual communities and "communities of practice"[11] can serve subject matter specialists, such as biotechnology researchers, or support communities of experienced laypersons, but the capacity of ICTs to connect communities to mentors in a form of "distributed technical assistance" is equally significant. Mentor networks

[11] Communities of practice are groups of people who come together regularly in a more-or-less non-hierarchical environment to discuss topics of mutual concern or interest.

seek to bridge the divide between specialists and laypersons by placing a person with specialist knowledge at the service of a group of persons with less specific knowledge. Several techniques exist for facilitating these types of specialist-practitioner linkages, including specialized websites (e.g., askjeeves.com, askme.com), discussion groups moderated by thematic leaders, topic oriented listservers, or even ordinary email and telephone. For example, in its Devleopment Gateway design, The World Bank uses "thematic and regional guides" as moderators.

Over time, one of the most important effects of ICT advances in developing regions will be to enable poor communities to connect more effectively with sources of assistance, knowledge, and financial resources. Virtual communities for laypersons, combined with an effective networks connecting laypersons and intermediary organizations with subject matter specialists, promises to be a powerful combination that can place a relatively small supply of specialist knowledge at the service of large numbers of needy people distributed in many locations. Specialists can provide useful innovations and suggestions through their participation in such communities, and if successful, the communities themselves can diffuse lessons learned widely without significant effort on the part of the specialist.

Linking specialists and researchers to communities of laypersons or intermediaries such as extension agents or NGOs can help resolve a perennial issue in agricultural research and extension: how to ensure that agricultural research can benefit the smallholder and how to disseminate the results of that research as rapidly and accurately as possible.

Commodity networks or "vertical portals." Within a specific industry or commodity, vertical portals or "vortals," can assist the members of a production chain in locating each other and coordinating the exchange of goods up and down the production chain. These portals are "vertical" because they explicitly target the needs of industry linked by a vertical production chain. As agricultural production chains become increasingly global, the capacity of vertical portals to serve as local market facilitators and sources of technical assistance increases substantially, as does the importance of allowing information about production methods (organic, socially responsible, etc.) to follow products as they move from the original producer to the end consumer.

The government of Brazil has helped produce an excellent example of a vertical portal for the Brazilian cashew industry, linking together key organizations (input suppliers, transporters, labor unions), keeping a common calendar of events, and disseminating industry newsletters. The site is currently developing a classifieds section for cashew products and the labor market.[12] Since its inception, the site has averaged more than 500 visits per month (15-20 per day), a substantial number given the challenges in Internet access that many of the site's users face. Moreover, the site is financed sustainably by the commodity association.

[12] See the cashew website at: http://www5.prossiga.br/caju/index.html – to translate, search for the site through google and select "translate this page."

E. Gender and Social Equity Issues

It is important to recognize, as with any technology transfer objective, that early access to technologies such as ICTs confers political and economic advantages to the groups that have them. It can also create or exacerbate conflicts or inequalities when access or information content is limited along gender, geographic, ethnic, or economic lines. Intelligent phasing and targeting of ICT access can empower key actors such as local intermediary organizations and help to manage or resolve conflict, as well as promote more equitable development outcomes.

1. Gender dimensions

The significant market advantages of access to communication and information have affected whole segments of the rural economy. This is especially true for women farmers.

Rural women are key actors in agriculture, biodiversity conservation, and rural economic development, but investing in female farmers is an overlooked strategy for increasing agricultural productivity. Many programs with good intentions overlook women's needs, mainly because researchers, policy-makers, and planners lack adequate data, information awareness, and methodologies to address them. Another important reason for this neglect is that the vast majority of researchers, extension agents, and other intermediate technology transfer agents have been male. A recent FAO survey showed that female farmers receive only five percent of all agricultural extension services worldwide, and only 15 percent of the world's extension agents are women.[13] This, in spite of data showing that women account for over 70 percent of domestic food production in Africa and more than half of agricultural labor elsewhere. Part of the reason is that extension services generally focus on commercial production rather than subsistence crops, which are the primary concern of women farmers and the key to food security in developing countries. In many cultures the information flow between men and women is limited, further blocking access to extension agents, most if not all of whom are male.

Male employees dominate the ICT sector to date, and special actions are therefore needed to reach female clients. Studies show that women with access to telecommunications are able to support a variety of productive tasks, including entrepreneurship and management of SMEs. Thus, ensuring that USAID's investments enable women to access ICTs is not just an issue of social equity, but also a method to generate a critical threshold demand for ICT services that can support sustainability and improve the overall productivity of the family and entire community. For more on this topic, see AED's *Gender, Information Technology and Developing Countries: An Analytical Study* funded by the Women in Development office of USAID.[14]

Telecenters are a common method of providing connectivity for a community. In some contexts, special provisions will be necessary to permit women to take advantage of the services that telecenters offer. Special women-only hours can help in situations where women might feel threatened or unable to go for cultural reasons. Scholarships and special training for women

[13] See FAO website: http://www.fao.org/Gender/en/educ-e.htm .
[14] See AED website: http://learnlink.aed.org/Publications/Gender_Book/Home.htm .

telecenter users and staff can help women overcome a variety of otherwise constraining factors. Women's access can be improved by locating telecenters where women go to perform other tasks or take advantage of local resources (e.g., health centers, libraries, women's NGOs).

Finally, the availability and relevance of women-centered content is essential for generating ICT demand and delivering value to women users of ICTs. One strategy is to help women produce their own content, either by promoting virtual communities, special women's community content-generating projects, or by having female extensionists identify, design, or otherwise select key items for women users.

2. Social equity issues

Inequalities and "technology rents." Experience with technologies in the green revolution highlighted the issue of "technology rents" in agriculture. Farmers with early access to green revolution technologies were able to outproduce and outcompete the non-adopters, in many cases putting them out of business and purchasing their land. These projects were a great success in terms of increasing national food production and land areas utilizing the new technology, but that success came at the cost of many smallholders unable to enter the market and a rise in both the rural landless and rural outmigration, mostly to periurban slums.

Information and communication technologies confer significant market advantages to those who have access to them and who have relevant content available. Those who take risks to adopt the technology should be allowed to reap the rewards of their risk and investment, but ensuring that international development spending creates equal opportunities and levels the playing field is also critical to rural security. The potential is real for a repeat of the social dislocation that accompanied the green revolution, and needs to be considered in EGAT/AFS' approach with respect to ICTs.

For example, if a government creates an Internet-based system to register and normalize rural land titles, individuals and communities – wealthy or not – with early access to the system may be able to stake the first claim, dispossessing those who lack access. Mechanisms exist to ensure verification, but they depend on careful up-front planning, as well as a well functioning legal system.

Literacy and computer literacy. Low literacy rates in many agricultural areas in the developing world present challenges to the effective use of ICTs, but these challenges can be overstated. With proper attention to user interface design, ICT kiosks can use multimedia to communicate through pictures, sound, and video. The Development Alternatives Group in India has produced a site for its Technology and Action for Rural Advancement "TARAhaat.com," designed for low-literacy users to help stimulate appropriate technology transfer and use in rural villages.[15] The site is still evolving and is not perfectly suited to an entirely illiterate audience, but it provides a proof-of-concept sufficient to justify future investment in the outlined approach.

[15] See Technology and Action for Rural Advancement site: http://www.tarahaat.com .

Ad-hoc collections of market, natural resource management, or instructional information can be placed in MP3[16] format or burned onto DVDs[17] for use in $50 community players. Young people are particularly capable of absorbing the visual keys and metaphors used in computer interfaces. Illiterate children, for example, encounter little trouble mastering video games that may not even be published in a language they understand. Although an agricultural ICT application may require more abstract thinking skills than a video game, the example shows that new technologies are not necessarily inaccessible to illiterate or traditional language communities.

Another strategy for low literacy situations is to work through literate intermediaries. This strategy is not limited to ICT deployment and is a common technique for working with semi- and illiterate populations. Under these circumstances, the project goal is to improve the general information environment of the community, and success should be measured by before-and-after surveys to examine whether information available to literate intermediaries has been able to migrate across the divide.

In an ICT-networked age, general literacy will become more important than ever as a key to development. As part of a general ICT approach, teaching literacy and numeracy will be a key factor in maintaining sustainable rural livelihoods and competitive smallholder agriculture, even when such literacy training is executed through traditional (i.e., neither mediated by nor oriented toward ICT) instruction methods.

The role of the women in literacy is critical. A number of studies have concluded that mothers and women have a much greater impact on children than their fathers when it comes to literacy and education.

Rights and social awareness in the new medium. The ability of ICTs to capture, record, and redisplay information can be a double-edged sword. New initiates to ICTs and the Internet may not know that data is being collected on them and may not understand how to protect themselves from identity theft, pyramid schemes, and a variety of other scams that pervade the Internet. They need to understand their rights as an online citizen and how to protect their privacy – not just the technology for "turning off cookies,"[18] but what requests for information should make them suspicious and cautious. In areas where rural human rights are precarious or AIDS carries severe stigma, capacity building needs to consider teaching users about local privacy laws and techniques for preserving privacy in the digital realm.

[16] MP3 is a digital audio formatting standard that can contain lecture, radio, and other material and be delivered to a variety of devices, including computers, MP3 players, and some CD players.

[17] DVD or Digital Video Disks are to video what traditional CDs are to audio, with the exception that they can store several gigabytes of information and can contain a limited degree of interactivity. DVDs are the size of an audio compact disk and are played in a VCR-like box which sells for as low as $50.

[18] "Cookies" are small files used by Internet browsers to store information about a particular user when they visit a web site. Frequently, cookies are designed to make websites more responsive and customized for a user, but they can also be used to track other data, such as identification numbers, passwords, and browsing habits. In response to privacy issues, most web browsers now allow users to refuse to store their information on cookies, even if that makes their use of the web less customized.

New users also need to be made aware of "netiquette" – the social rules that take place over the Internet, so as not to inflame others and to promote maximal cooperation. "Elite" users with larger bandwidths and more powerful processing equipment need to understand the dos-and-don'ts of communicating with low connectivity areas: issues such as asking before sending megabyte-sized email attachments, or making an attachment available over the web, so that users can download it at a more appropriate moment.

Internet access raises important community standards issues that connecting communities need to discuss and come to explicit, publicized consensus. The availability of pornographic material over the Internet has actually helped sustain ISPs in some locations, but has forced them to close in others where such material is illegal. The availability of politically and culturally sensitive material through ICT networks requires up-front consideration, particularly in China and the Middle East, where these issues are lightning rods for government security forces.

Finally, it is important to promote the free flow of information between digital and non-digital modes. Digital does not necessarily mean "better," even if the advantages of searchability, customizability of information, and communication speed are significant. Most non-digital ICTs continue to function when electricity fails, and items such as books require fewer maintenance visits than computers. Users of the new medium need to understand that information is not necessarily more true or accurate because it arrived on a computer. Indeed, if they can learn how to create a website or space for themselves online, they may be better able to evaluate the quality of net-based information with a critical eye.

Information and access: private commodity or public good. Efforts to keep rural access to ICTs and ICT-based agricultural content up-to-date and financially viable usually center on the capacity of local investors to aggregate and sell information or access to information. On average, this is a good and necessary approach, but in some circumstances information and access to it closely resemble a public good threatened with undersupply by market failures.

For example, information about civil rights, labor rights, basic knowledge of how to access government services, and other issues present compelling reasons that access to *some* ICT services needs to follow a public goods model. This does not mean that every individual should be guaranteed a computer and dial-up connection, but it does mean that individuals need to have places where they can access information that falls into the public goods category, even if such locations cannot sustain themselves on a user-fee business model. As governments consider offering more of their services through an e-government model, the danger exists that rural communities without access will lose even the government services they presently have. In some cases, USAID's ICT efforts will have to support a balancing between a public goods provision model and an entirely private, market-driven model.

CHAPTER II
THE FEASIBILITY OF ICT IN RURAL AREAS

Some development planners have been skeptical of the cost and benefits of ICT-enhanced strategies over traditional modes of agricultural development assistance since the beginning of the digital revolution. Equipment costs, the technical infrastructure requirements to support PCs, and electrical scarcity in rural areas may at first make ICT investments seem uneconomical. On closer examination, one can easily overestimate the costs and underestimate the aggregate benefits that ICTs can bring, particularly if one starts from the assumption that ICT interventions are limited to desktop computers connected to the Internet. This chapter discusses financial considerations, long-term sustainability, technical issues, rural power requirements and some emerging technologies that are likely to impact the costs, benefits, or applicability of ICTs in rural areas.

A. Financial Aspects: Up-front Costs and Long-term Benefits of ICT Approaches

Investments in ICTs look quite inexpensive compared to the cost of large infrastructure investments such as hydroelectric dams and road systems. However, they can seem quite costly compared to the average income of a poor family. On balance, well-planned ICT-enhanced interventions tend to *boost the impact and longevity of development assistance*, while simultaneously *assisting with monitoring and knowledge gathering* in project activities. These effects occur because the number of uses for ICTs tends to increase over time as more users become familiar with the technology and as new ICT-based services or content become available.

In Winrock's Volunteer Technical Assistance programs, Internet connectivity options in some locations have allowed volunteers on assignment to be more effective by consulting professional associates while abroad. Where ICT connectivity exists, Winrock's volunteers not only bring their own experience, but also their entire professional network, multiplying the value of their time and the number of problems they can help communities resolve. Moreover, Winrock management can keep track of project progress better, allowing for faster problem diagnosis and more flexible solutions. Finally, Winrock has found that many volunteers now keep in touch with communities they visited via email and continue to provide them with remote advice and technical assistance long after their official assignments end.

Similarly, in Brazil's Alvorada Project, Winrock has observed what many others have reported. After accessing ICT services in municipal centers, and learning how to use them, communities have developed new and previously unimagined applications for the technology that continue to add value beyond that originally planned. Effective monitoring and evaluation methodologies for ICTs need to take account of these new "unintended" uses for ICTs after deployment, so that the additional benefits they provide can be included in the cost-benefit calculations during project evaluations.

It is presently extremely difficult to measure the cost effectiveness of ICT investments in agricultural development activities accurately. Many ICT and ICT-enhanced projects are still in a pilot stage, where final costs and benefits are not fully tallied, and many costs associated with the "ICT learning curve" are included. More significantly, the prices associated with ICTs themselves change rapidly, so that ICT uses equipment prohibitively expensive only a year ago might be sustainable under today's conditions and prices. Finally, some successful technology costs disappear into overhead and the "cost of doing business." Telephones and university email charges once required special justifications in project budgeting, but today are standard overhead expenses for larger organizations. The same will likely happen to web hosting charges and PDA expenses in the future: as they become normal business practices, they become difficult to track.

Technologically, three key trends affect the cost-effectiveness of ICTs into the future:

- Rapid increases in available computing power pushes down the cost of older ICTs, making smaller amounts of computing power more available to those with more modest budgets (e.g., personal organizers, cell phones, digital audio devices, digital cameras, DVDs and other devices can now be found for less than $100).

- As more devices become digitally enabled and more people and services connect to a global network, the chance that ICTs can facilitate valuable interactions usually increases (e.g., more opportunities for international remittances as rural communities connect to migrant family members).

- Unlike many agricultural technologies (e.g., tractors), ICTs are highly multi-purpose, meaning that an investment in ICT connectivity can potentially produce value and impact over a large set of important development indicators (e.g., an agricultural telecenter might also serve health, credit, and education purposes).

Together, the overall trends indicate that technology costs will stay the same or decline, whereas the total benefits are likely to rise over time. The present is therefore a good time to invest in pilots to understand and perfect the services that agricultural communities will require as access becomes more widely available. The applicability of any specific ICT approach will naturally depend on specific conditions: local knowledge of the policy environment, the electric and communications infrastructure, and the human skills base available to take advantage of the connectivity and content that these larger ICTs trends promise.

ICT strategies in agricultural development typically fall into one of four broad categories, or some combination: connectivity provision, capacity building and training, content development (including software applications) and repackaging, and conducive policy and governance. Each approach has its own dynamic in terms of costs versus benefits and overall impact.

1. Connectivity provision

Connectivity approaches seek to provide target groups with new or upgraded access to ICT equipment and communications capabilities so they may connect to information networks and

process the information they need. In rural areas, these approaches often include power systems for running electronic equipment off of the electrical and communications grid. Connectivity provision can be the most difficult activity to undertake cost-effectively, because up-front equipment costs can be substantial, ICT hardware may depreciate rapidly, and servicing and maintenance usually demands that effective management practices be in place.

Connectivity projects seeking to upgrade existing ICT facilities with new or more powerful equipment are easier to implement cost-effectively, since many critical support features are typically already in place. Nonetheless, basic connectivity in one form or another is a *sine qua non* to virtually all ICT objectives and cannot realistically be avoided in any project portfolio with ICT-related goals. Aggregating ICT use across a variety of applications (e.g., email, input prices, rural health, technical support, entertainment, voice) will tend maximize the total value ICTs ultimately provide and increase the possibility that target communities will be willing to pay for ICT connectivity on a sustainable basis. Aggregating uses implies that EGAT/AFS will be willing to share hardware equipment investments with other donors, sectors, NGOs, or private firms in order to promote improved ICT connectivity, and leverage their beneficiaries in any cost recovery efforts.

Voicemail and Pagers that Connect to the Internet

In Peru, a for-profit company, Voxiva, is pioneering "voicemail and text-to-speech for rural communities." The idea is to help remote communities receive technical assistance through a community voice-mail system. As a result, rural farmers save money and time on long distance calls, paying only when they send and receive responses. Users reduce telephone expenses for time spent on hold, with fewer calls back to talk to someone out of the office. Some of the voicemail services can be automated.

Pagers and instant messengers are another inexpensive mechanism for communication. In theory, an instant messaging "bot" could receive a request for price information from a pager or Internet instant messenger, check a database, and return an instant message with the location, price, and quantity. Such a system can offer databases of agricultural information inexpensively and without requiring traditional technologies for web access.

New approaches that could reduce the cost of connectivity in specific contexts include the development and marketing of low-cost computing devices (e.g., the "Simputer"[19]) or creation of systems that would facilitate the donation or discounting of equipment and bandwidth from the private sector.

2. Capacity building and training

Capacity building programs seek to build the skill sets necessary to use, maintain, manage and integrate ICTs in the context of agriculture. They can include training an organization to leverage access to communications networks, design an ICT presence or ICT-based marketing strategy, and manage technology planning. Capacity building strategies in ICT usually presuppose some existing connectivity, but are generally quite cost-effective because they introduce techniques and skills that remain in the community long after the training is complete – particularly when targeted at organizations and networks rather than individuals. Moreover, as

[19] The Simputer is a portable computer designed for use by low-income and semi-literate people in developing countries, set at a price point of roughly to $200. See: http://www.simputer.org .

equipment changes in response to new technologies and prices, many ICT skills continue to be transferable to new technologies and can help identify new and innovative uses for ICT capacity. The transformation of thinking that individuals undergo after exposure and training in ICTs is significant in itself, and key to generating demand-driven growth for ICT services in agriculture or other areas. This result is in itself a significant development outcome.

Capacity building extends beyond individuals and institutions to include networks of individuals and institutions. ICT capacity building thus includes online-community and professional network building. Since a major feature of ICTs is the ability to connect distributed individuals inexpensively, connecting ICT-enabled target groups to a network of peers and sources of technical or social support. This is often best achieved through face-to-face community building followed up by e-mail and other communications methods and periodic face-to-face reunions.

3. Content development and repackaging

One of the main objectives of connectivity provision and capacity building is to provide target communities with the ability to access meaningful information and useful content that can lead to more economically efficient, socially just, and environmentally sustainable decisions. In practice, although a wealth of English-language content is available on the web, specific, localized, and local-language content relevant to USAID's poorer target clients and program objectives is often lacking. This is an important gap in the use of ICTs in agriculture development that USAID can help fill.

Investments in content development, packaging, and repackaging can be extremely cost effective if they are designed to meet critical agricultural needs, because they can leverage the Internet or CD-ROM delivery systems to reach large numbers of people as access, connectivity and capacity building efforts expand. Adherence to HTML, XML,[20] or other international standards can help to ensure that digital content can be distributed widely and inexpensively.

Many information and learning needs in the agricultural sector change far more slowly than present ICTs do. Long after the present generation of computers becomes obsolete, rural farmers will still need to know how to register title to their land, identify and respond to pests, access credit, and protect their civil rights. As a result, investments to develop digital information and content today are likely to retain their value to communities and continue adding value long after the original project has ended. Finally, inexpensive mechanisms and economic incentives for local communities to generate their own relevant content and share with others will help to supply digital agricultural libraries with an adequate stock of case study information to improve the quality of agricultural research, extension, and management.

4. Conducive policy and governance

In many locations, national and local policies represent key barriers to effective ICT deployment and use. National telecom monopolies, the absence of consumer protection laws, legal structures

[20] XML stands for eXtensible Markup Language, and is a set of rules for defining new forms of data on the Internet.

for e-commerce or privacy protection, as well as local tariff policies can severely impede ICT efforts in agriculture. Similarly, the absence of regulatory standards can destroy the incentives for businesses and NGOs to deploy ICTs productively. On the whole, investments in policy change tend to be relatively inexpensive, targeting a relatively small number of key decision makers and policy insiders, whereas the benefits in terms of more productive ICT investments can be substantial to all involved. As a result, policy reform can be an extremely cost effective investment that can leverage private sector participation, provided it is followed up with concrete, on-the-ground projects.

B. Sustainability of ICT Investments and Market-based Cost Recovery Mechanisms

Project sustainability is a key issue in ICT and ICT-enhanced projects. Donors rightly resist the notion of financing a specific activity and organization year after year with no independently sustained funding in sight. Given the need to pay for equipment upgrades and maintenance, telecommunications costs, and the high cost of many ICTs relative to local salaries and abilities to pay,[21] the sustainability of ICT efforts in rural agriculture can present significant challenges.

1. Telecenters and aggregating ICT use

Some aspects of ICT-enhanced work are difficult to deliver in a financially sustainable manner. Telecenters[22] providing ICT connectivity for rural zones and off-grid areas are frequently difficult to sustain past a project close. Governments sometimes take up slack by sponsoring telecenters, borrowing a "local librarires" model from the low-tech world. Low population density areas have experimented with a "technological bookmobile," in which a bus with computers and solar or hybrid energy systems makes periodic stops in rural villages. Technological busses are high flash, frequently sponsored by global corporations, but difficult to sustain. A Brazillian technological bus, for example, was robbed in Rio de Janeiro. Nonetheless, new strategies that involve partnering with local entrepreneurs to establish and run community Internet centers as for profit business ventures demonstrate that providing some rural communities with sustainable access to ICTs is possible.

Sustaining telecenters often involves aggregating connectivity and use over a variety of demand-driven needs. This means that a telecenter initially supported as part of an agriculture project may need to serve multiple uses that go beyond agriculture to include uses in rural health, distance education, teacher support, IP or regular telephony, or entertainment to be sustainable. In China, for example, some telecenters sustain themselves with 80 percent of their revenue from

[21] In developed countries, ICT deployment frequently leads to cost savings and efficiency improvements because it replaces expensive worker time. In developing countries, where salaries can be significantly lower, ICTs may need to provide even more value before they represent a genuine cost savings to the users.

[22] Telecenters are local centers that provide computing equipment and (often) a connection to the Internet, usually along with telephone, fax, and printing services. Usually telecenters are run as small businesses, but some can be community access points supported by public funds.

the sale of video game time, but this business strategy also enables them to be a resource center for agricultural support materials on CD-ROM or the Internet.

Aggregated demand strategies may require more nuanced partnerships with other USAID sectors or other donors interested in supporting health, education, communications, or other ICT-enhanced needs, and misunderstandings of responsibilities can arise. For example, in the video-game case, the video games may prove essential to telecenter sustainability, but a donor might react unfavorably if 75 percent of the maintenance needs resulted from video-game usage and not agriculture, even though 80 percent of the center's income flows from these sources.

2. Alternate access strategies: low-cost and low-power ICTs

Another strategy for sustainability is to push beyond the traditional cyber-café/telecenter model and consider smaller, simpler, more robust and less expensive devices that can connect to digital information networks. Recognizing that small quantities of connectivity and computing power can go a long way in truly isolated areas, the Grameen Bank in Bangladesh has developed a model in which rural women purchase cell phones with microcredit loans and sell telephone services in their villages. Not only does this model pay for itself, but it has low technical and literacy requirements and still adds considerable value to village life. According to studies, the most common uses of the telephones are to speak with remote family members, find market and price information, and facilitate remittances from relatives working in cities or abroad.[23]

In the Philippines, text messaging via pagers and cell phone is extremely popular and inexpensive, and although cellular coverage remains patchy in rural areas, it is expanding rapidly, and the government has plans to facilitate VSAT satellite capability throughout the islands by 2005. In Uganda, the use of text messaging via cell phones enabled fisher folk to learn current prices for fish in different markets, thereby increasing revenue and allowing the users to take greater control of their fishing businesses.

Game consoles such as the $250 Sony PlayStation 2 are essentially inexpensive computers that can connect to a community's television set, offering some communities an opportunity for buy-in with their own capital. Game consoles tend to be relatively durable, employ fairly simple user interfaces, and can already be found in many periurban shantytowns with surprisingly low incomes. Game software is supplied on a CD, but there is no reason that such software could not also provide agricultural information, diagnostic applications for communities, or distance training programs. With a $50 addition, the PlayStation 2 can connect to the Internet. Microsoft's X-Box is designed to connect to the Internet for game play out of the box.

Personal Digital Assistants (PDAs) or handheld computers such as the PocketPC and the Palm Pilot can be purchased for as little as $100-150 for entry-level models in the United States. Access to PDAs, with suitable applications, can enable extension agents and resource managers to bring with them a library of reference material and decision-tree software, allowing them to

[23] See Telecommons Development Group report at: http://www.telecommons.com/villagephone/contents.html , especially chapter 2. See also OneWorld article at: http://www.oneworld.org/ips2/aug98/14_23_053.html .

travel more freely to client sites and empowering them to survey economic, social, and agricultural data as they go. PDAs can create new roles for the local extension agent, such as performing on-the-ground surveys, and can link them more closely to the agricultural research community while taking advantage of the mobility PDAs afford so that they have more frequent contact with client farmers.

None of these strategies offers a guarantee that ICTs and connectivity investments in rural regions can be sustained beyond a project's lifetime, but they can significantly lower the costs and usage requirements for sustainability, while pushing the connective frontier closer and closer to the poorest and most vulnerable. Advocates of some of these less conventional technologies are sometimes accused of advocating "technology push," but as Don Richardson of Canada's Telecommons Development group noted, "we need to move from asking 'what can we do with this,' to 'what technologies can help here'."

3. Dimensions of sustainability: more than sustaining a single organization

Finally, given the drive for sustainability, it is important to consider exactly what needs to be sustained. Usually, sustainability is measured organizationally: a project might be considered unsustainable because a telecenter eventually had to close down and lay off its staff. However, if a project telecenter closed because it could not compete with a less expensive local center, then the community still has access to ICTs, and overall project goals are still met. Similarly, any digital *content* produced during a project can reside on servers beyond the local telecenter, delivered to other communities in several ways, and can also be sustained for future use at relatively little cost. Finally, the transformation of worldview that accompanies exposure to ICTs and the Internet is still latent in the former users, increasing demand for future, perhaps less expensive options. Search skills, organizational skills, and familiarity with computerized user interfaces are important capacities that will continue to serve communities well as they encounter ICTs more and more frequently.

Sustainability: Thinking Beyond Telecenters

Sustainability has many dimensions other than the survival of a single organization.

e.g., "The telecenter closed but…"

- The telecenter couldn't compete with cutthroat "mom and pop" Internet centers that now provide relatively inexpensive connectivity.
- All content generated by or produced for the project is available for reuse by other interested communities.
- Project participants and beneficiaries are better equipped to use the ICTs they now encounter.
- Demand for ICT services increased and created a market for services delivered on less expensive equipment.

C. Technical Aspects of ICT Feasibility in Rural Areas

Some of the most important hardware considerations in ICT and ICT-enhanced projects were covered in the preceding section, which emphasized the importance of moving beyond a computers-laptops-Internet model when using ICT to integrate information systems for agriculture. When working with international agricultural researchers, national government

agencies, universities, and other more "elite" organizations, desktop/laptop-cum-Internet and Internet portal approaches make sense, but more remote, less affluent, and less literate areas may demand alternative hardware systems that suit local needs and capacities.

A key concept for linking central computing centers to remote needs is *server-side processing*. Server-side models of information processing allow users with relatively basic equipment (e.g., older computers, PDAs, cell phones, pagers, or other "*thin clients*") to take advantage of powerful computers on the far side of a telecommunications connection. The more powerful computers accept simple commands and small quantities of data, process it (often in conjunction with large data sets of its own), and communicate only the results back to the more simple equipment. In this manner, a relatively simple computer or PDA can access powerful GIS software and large databases over the web. The key to using these technologies effectively is that the software on the more powerful end must be designed to know that it will communicate with less powerful clients, and be able to handle requests from devices other than PCs.

Gender dimensions can also be important in making hardware and software choices. Many devices are "gendered," meaning that cultures may tend to associate a device with men's or women's uses. Because of the PC's association with science, for example, many cultures think of it as a device for men to use, but the cell phone is frequntly more accessible to women, because of its association with communication. The modern PC is such an important and flexible device that it is critical to ensure that women have access to it and feel comfortable using it, but in designing content and content delivery that meets women's needs, it can be helpful to consider which ICT-enabled devices are most readily available to women and which devices women feel most comfortable using. As microchips find their way into more and more everyday devices, consideration for the "gendering" of devices can help meet women's information and communication needs in agriculture and other areas in new ways.

PCs vs. Other Digital ICT Equipment

Desktop and laptop PCs are presently the most flexible and versatile pieces of equipment in the ICT inventory. They are also among the most complicated, crash-prone, and maintenance intensive, and they have the highest literacy requirements for effective use. Desktop PCs in off-grid areas also consume significant quantities of costly power.

In some cases, PDAs, cell phones, pagers, game consoles, and DVDs offer robust, simpler, more inexpensive alternatives, but they are often less flexible in their applications and their ability to aggregate demand.

Another critical consideration is appropriate and relevant *content*, which can be stored and retrieved in digital form (e.g.,documents, pictures, multimedia, databases, software applications, etc.). Content – along with communications and coordination – is what drives demand for digital ICTs and makes them so valuable. A good portion of agriculture applications of ICT seek to make content available via ICTs to populations that need it, but in the content design, it is important to produce content blocks as Reusable Information Objects (RIOs) so that they can be reused in a variety of desired contexts. This is particularly useful in distance-education or teacher support approaches, so that a course can be composed and recomposed of several RIOs ordered and reordered.

Aside from the production of RIOs, a critical opportunity not to be missed is the capacity for decentralized content production, whereby communities themselves create and/or evaluate the information content that they most need. The lessons learned by having communities search for, choose, and/or design their own content can be extremely useful for other communities in similar positions – not to mention donors – provided that a sensible library strategy for sorting and organizing such experiences has been planned in advance.

DFID and Open Source Software

The British Department For International Development (DFID) has begun to insist that all software developed explicitly with DFID funding use open source licensing models, so that software is accessible for future improvement by DFID or other development oriented organizations.

Finally, in considering software applications, software development, and international development, there are three models to choose from: proprietary-commercial, proprietary-free, and open-source.[24] The essential decisions in what mode to use are: a) whether a software product should be available free of charge or at a price, and b) whether the code should be open for a community of developers to update and make continuous improvements. Depending on the software and expected users, proprietary commercial software may be priced out of the reach of many potential users. Free software is more accessible, but the producer lacks incentives to meet the quality and requirements of the end-user and can undermine the incentives of private companies to produce better alternatives. Open-source software communities generally produce software that is inexpensive and high quality, but its output rate is highly unpredictable, and it can be difficult to manage and meet deadlines. As EGAT/AFS deepens its ICT strategy, it will no doubt identify some key software applications that, if available, could add value to rural livelihoods and the agricultural value chain. In each case, the software development licensing choice will depend on project specifics. Open-source approaches are generally considered more compatible with the goals and values of the international development community, but at times a proprietary strategy, commercialized or free, is more appropriate.

D. Energy Needs and Rural ICTs

Electricity and power supplies are absolute prerequisites to using contemporary ICT systems. In rural areas of developing countries, over 1.5 billion people lack relatively inexpensive grid or 'mains' electric service, and extending the electric grid is often prohibitively expensive. Many developing countries are currently extending their electric grids, but vast numbers of communities amounting to over a billion people will continue to lack grid electricity for the foreseeable future. For these people, other energy options are essential if they are to benefit from rural ICT use.

Several "off-grid" energy options exist for rural areas. Small renewable energy-based power systems such as solar photovoltaics (PV), small wind-electric turbines, or hybrid[25] power

[24] Open-source software is not by definition free, but with some work, it can usually be compiled installed free of charge. Some companies charge for helping to facilitate the installation, but these charges are generally considerably less than the cost of proprietary commercial alternatives.
[25] Hybrid energy systems combine renewable and diesel sources.

systems are often ideal for powering information and communication systems. Compared to other agricultural equipment, ICT power requirements are relatively modest, and small-scale renewable energy or hybrid systems will often be the least-cost options for ICT electrical needs.

Fossil-fueled generator systems can be viable for many uses, but these systems have fewer advantages for rural ICTs. Diesel generators often generate low-quality electricity that can damage the sensitive components of an ICT system, and diesel generator operating costs and operational requirements – especially maintenance and repair – track closely with total hours of operation. Such costs may mean that a diesel generator can run only a few hours each day, restricting use for a rural telecenter and reducing potential revenue. Power conditioning equipment, battery banks, and the inclusion of renewable energy components can overcome some these issues, but they increase the total system cost and its complexity. Finally, institutional factors can make diesel or gasoline generation systems in many rural settings inherently unreliable.

For renewable energy technologies (RETs), the initial purchase cost can be considerably higher than a small diesel or gas generator, but they are generally far more reliable in sustained operation. The cost savings over equipment lifetimes – in fuel, operation, and maintenance – can make RETs a much more economically viable option. Solar PV is the most common RET option for rural ICT installations, since solar energy resources are broadly available in most developing countries. In unelectrified areas, solar PV will often be the most appropriate power source, assuming that planners pay attention to the energy efficiency of ICT equipment.

Renewable energy and hybrid systems have powered many off-grid telecom repeaters for several decades. Because repeaters have high costs and play a critical role in the telecom networks, companies devote serious attention to these off-grid power systems, designed and sized by experienced power system engineers from telecom firms or their turn-key contractors. Telecom companies increasingly use off-grid renewable energy systems – typically solar PV – for end-user and customer-side equipment in wireless rural telephone systems, including PV-powered rural pay-phones.

Rural computer and ICT equipment selection can have substantial and counterintuitive cost impacts. A telecenter with standard desktop computers and CRT monitors can demand two to five times the power of a similar telecenter with laptop computers or energy efficient desktop PCs and LCD monitors. Laptops, energy efficient PCs, and LCD monitors might at first seem expensive luxuries, but the savings in electricity and power system costs will generally far outweigh the additional ICT expense. Depending on usage, the off-grid power system to support a standard desktop PC can easily add an additional $2,500 to $3,500 per computer. Decision-makers may not always be willing to choose laptop computers, even for off-grid sites where solar PV will be used. In these situations, highly energy efficient desktop computers (a few available) utilizing LCD monitors are options. Another alterative is to explore using very low power handheld computers or “thin clients” linked to a smaller number of PCs.

The growing use of information and communication systems in rural areas means that organizations and people who lack rural power system expertise will begin make more and more

equipment selection decisions – including power system selection. Given that technical details in energy can dramatically affect the lifetime cost and sustainability of rural ICT use, pro-active information dissemination and capacity building for cost effective off-grid ICT and power equipment selection will be a necessary component of USAID's approach to rural ICTs.

E. Promising Emerging Technologies

Even after the technology bubble of the 1990s, many information and communication technologies are advancing rapidly even as technology prices continue to fall. These trends suggest that more and more ICTs will become affordable at any specific income level over time. High-cost technologies concentrated in capital cities and regional centers are not necessarily inaccessible by remote communities, since server-side processing models can often facilitate shared access.

Falling costs will help to increase the availability of ICTs, but the demand for technologies and the services they enable also depend on the quality of content, its transparency, and reliability. Ease of use and attention to user interface designs will prove essential to adoption and will require explicit integration into ICT-enabled agriculture projects. With these caveats, table 2.1 identifies some important technologies entering the ICT and agriculture mainstream, as well as some others which are on the horizon and may become more widely applicable over the next few years.

Table 2.1: Evolving technologies for ICT applications in agricultural and rural ares

Some technologies in or entering the mainstream	Promising technologies on the horizon
• Database-driven websites • Digital Photography • Server-side/distributed computing • Cellular phones • Short-Message Service (SMS) • Instant Messaging • Geographic Information Systems (GIS) • PhotoVoltaic (PV) power for ICTs	• Wireless (VSAT, Wi-Fi, Bluetooth) • Portable flash media • DVD burning and design • Biometrics • Voice-recognition/text-to-speech • Translation software • Fuel Cells for ICTs

1. Technologies in or entering the ICT-for-development mainstream

How fully technologies have entered ICT-for-development thinking depends to some extent on the application imagined and a target country's level of development. In the field of websites and web portals, static websites are now giving way to dynamic websites driven by connections to online databases. One example is as the PinoyFarmer price database (www.pinoyfarmer.com) established by Winrock and the Philippine Department of Agriculture. Geographic Information Systems are increasingly used by urban, rural, and natural resource planners, and development

specialists have learned about server-side computing and application-service-provider (ASP) models, even if relatively few have as yet been launched.

With the prices of digital photography dropping rapidly, low-end digital cameras are now available for as low as $35. Some cellular phones now come with camera attachments, and many cameras can even take short videos. In many cases, these photographs and videos are grainy, but they can be invaluable for facilitating a "distributed technical assistance" via ICTs. A farmer or extension worker with a digital camera or camera-equipped phone can take a photograph of a crop blight, send it via Internet to an online technical assistance center, and have a diagnosis without requiring a physical visit by a specialist. Such a system could save time and money, and allow remote specialists to service many communities simultaneously.[26] Photographs, digital and otherwise, are important for tracking natural resource usage and health. However, since the cost of an additional digital photograph is nearly zero, and the cost of a conventional photograph in both time and money is higher, digital cameras often result in the availability of much more visual information available both to and from a field location.

More technologically savvy community organizations have at least considered open source software such as Linux and the Apache web server, which are either free or low-cost alternatives to proprietary software such as Microsoft Windows and Microsoft IIS. In fact, most Internet service providers in the developing world, and many in industrialized countries, run their ISPs off of Linux and Apache servers. Linux is generally not considered user-friendly as a substitute for everyday desktop computing, but it is inexpensive and can often run on relatively old equipment.

Half of humanity *has* made a telephone call… thanks to the cell phone…

According to Wired magazine (October 2002), it is no longer true that half of humanity has never made a phone call. The rapid expansion of cellular networks and new models of communications aggregation (e.g., the Grameen bank's "phone ladies") suggests that humanity crossed the 50% line at some point between late 2001 and mid 2002.

Cellular telephones are no longer considered extravagant luxuries in development work and are now even the object of microcredit loan policies. Many newer cell phones include the ability to send and receive Short Message Service (SMS) or text messages on their screen, often at significantly lower cost than a telephone call to acquire the same information. "Texting" has become a standard communication method among young Filipinos. Some cellular services also include their own ISP. In Kenya, the Yes! Cellular service reaches 90 percent of populated areas and can connect to a laptop at 9600 bps at prices comparable to standard ISP.

Many rural organizations with some degree of Internet connectivity are now using instant messaging (IM) to communicate with partners and colleagues at a distance. The cost savings on long distance and international communications can be considerable and may facilitate access to technical assistance that would otherwise be unavailable. The growing convergence between

[26] Of course, not all diagnoses could be handled remotely, but many can. In Winrock's experience, several physical volunteers in the Volunteer Technical Assistance program noted that could have provided nearly the same level of service remotely if they had been able to receive critical information via photographs.

cellular SMS services and instant messaging has powerful implications for rural information delivery, especially when combined with "instant messaging 'bots'" which can utilize artificial intelligence algorithms to respond to correctly phrased IM or SMS requests.[27]

For rural zones off of the electricity grid, photovoltaic electricity and even hand or pedal-powered generators have been successfully deployed as answers to ICTs in unelectrified areas (e.g.,Freeplay hand-cranked radios). The electricity requirements of some ICTs are low enough to make solar powered ICTs a viable possibility for applications where a small amounts of computing power can make a big difference. A solar powered palm pilot, with software to help evaluate rural creditworthiness is one example. A solar powered cell-phone with built-in camera could photograph a blight or pest and store it until an extension agent visits an area with cellular connectivity, where it could be transmitted to a remote site for diagnostics.

2. Technologies on the horizon

Emerging technologies that USAID should track and pilot at the appropriate time include a whole class of wireless networking mechanisms – Wi-Fi (802.11x networking), Bluetooth, VSAT and others.[28] VSAT and other satellite technologies, including the Low Earth Orbit (LEO) satellites used by Volunteers in Technical Assistance (VITA) have important implications for rural zones, where extending even cellular networks can be expensive. Local wireless solutions such as Wi-Fi have important implications as well, particularly when smaller devices such as PDAs, cell phones, and digital cameras can attach to them. Wi-Fi and Bluetooth can potentially overcome peculiarly social issues in ICT deployment. For example, for social reasons, new and powerful computers frequently end up on the desk of the "most important person" in an office, rather than a communal area where connectivity and power can be shared. Wireless devices can leverage such machines to provide computing power and the Internet to other office members of an office, even if the main machine sits relatively unused on a supervisor's desk.

Burning Opportunities with DVDs…

An extension agent could order a DVD over the Internet from a university or research center. When ordering, the agent customizes the DVD to provide materials the crops, livestock, or technologies he or she requires. The DVD is delivered by mail or courier and can play on a $50 DVD device. DVDs also have limited interactivity that can be exploited for instructional use. An entrepreneurial extension agent could also record his or her own material.

Linking satellite connectivity to local wireless is potentially a key manner of bringing Internet connectivity to a rural zone. A VSAT satellite dish can be connected to a wireless router, which will then allow people within the local wireless radius to upload and download emails, use instant messaging, or potentially even use voice-over-IP to connect globally. Essential to

[27] For example, the SmarterChild bot on the AOL Instant Messenger system can answer questions about local weather, movie times, etc. by adding SmarterChild to a user's IM buddy list and asking it a question.

[28] VSAT or Very Small Aperture Terminal is a technology for sending digital data via commercial satellite. A box connected to an antenna routes information to a satellite which sends it back to an earth base station connected to the Internet. Available speeds are faster than a dialup connection and the technology is especially attractive for remote areas off of the communications grid.

making such a system work at scale is software that can track individual usage and at least measure, if not charge for, the costs of each individual's bandwidth use.

Portable flash media and CD-ROM burning can solve issues where rural power exists but rural communications fail. For information needs that are less time sensitive, couriers on foot, horseback, or motorcycle can deliver information updates. Flash media can provide rural villagers with the ability to port their own data from location site to site.

Current high-end personal computers now permit users to create their own DVDs. Presently the process is still somewhat expensive and technically sophisticated, but it represents a tremendous reduction over previous DVD production costs and promises an unprecedented flexibility in providing technical assistance knowledge to literate and illiterate communities. Apple's $1800 iMac G4 with DVD burner, blank DVDs at $5 each, and free iDVD software illustrate the order-of-magnitude costs for the process.

The implications of DVD burning are impressive. It is not hard to imagine an extension agent ordering a DVD over the Internet to be delivered to a specific village, to be played on a $50 DVD player connected to a local television set. In ordering, the extension agent could customize the DVD to specific crops or technologies appropriate for his or her client, order a subscription for updates, or even contribute his or her own training techniques to the DVD library. DVDs also have a limited degree of interactivity, which will no doubt expand in the future.

Biometric technologies still tend to be expensive and experimental, but can be used to help illiterate people maintain Internet accounts or help gain access to banking and/or government services. The systems for using biometric data and preventing identity theft still need to be developed, but they can probably learn from existing experience with "smart card" systems for handling rural credit.

Also useful for situations where literacy is a challenge are voice recognition and text-to-speech, which promises computerized kiosks that can hold discussions with semi- and illiterate persons, or those with disabilities. The cost and performance of these systems is highly varied, but the technology has improved considerably in recent years. In the United States, Amtrak has a voice recognition system for booking trains.

Voice recognition and text-to-speech could open up even wider areas of ICT-based content if combined with translation technologies such as "babelfish." In this author's opinion, translation software still has much development ahead of it before it can be accurate enough to be truly useful, and may never actually materialize, but the technology is worth tracking.

Finally, in situations where rural electrification is a constraining factor, low power computers and fuel cell technologies could transform the cost structure and models of rural computing. Fuel cells appear to be evolving more slowly than anticipated, but it is clear that fuel cell producers see power for ICTs as a key application, particularly low power devices such as laptops, PDAs, and cellular telephones.

CHAPTER III:
ACTIVITIES OF USAID PEERS AND OTHER ORGANIZATIONS

As USAID develops its agriculture ICT strategies, it is important to understand what activities major players in the sector are undertaking. USAID is rightly concerned about avoiding duplication of effort and recognizes that the principal international development arm of the United States can play a special role in ICT for agriculture and related development sectors. This chapter provides a brief scan of the ICT-related activities being undertaken by major donors in international and agricultural development, organized by prominent themes and approaches to agricultural and rural development challenges. In a document of this size and scope, the coverage of such activities must necessarily be illustrative rather than exhaustive, with the goal of providing an overall sense of donor strategies and to identify significant sample activities currently underway in the areas of agriculture and ICTs.

ICT-for-development has emerged only recently as an area of sustained interest from the donor community, and even so, the use of ICTs in developing country agriculture has tended to lag behind other ICT-for-development applications. The lag in ICT use for agricultural development relative to other areas is not surprising, given that rural areas often present additional challenges in the need to develop rural infrastructure and human capital. In addition, agriculture is not often perceived as an information intensive industry in the same way as banking, tourism, or ICT itself.[29] As a result, donors have typically limited their use of ICTs in agriculture to experimental pilots that apply a variety of ICT-enhanced strategies and applications, and there has as yet been relatively little differentiation between donors in terms of broad overall strategies for using ICTs to enhance their agriculture development programs. ICT enhancements to agricultural and rural development projects can be organized into the following general classes or "the four C's" – connectivity, capacity building, content, and conducive governance (See table 4.1).

On the surface, it would seem a relatively straightforward task to survey the ICT and agriculture activities of the major donors. In fact, although descriptions of some useful individual projects are available, the overall strategies, funding allocation levels, and distinctive approaches are much more difficult to extract. This is because there are generally two organizational locations to look for agriculture-and-ICT programs. The first is within a donor organization's ICT-for-development strategy – if the organization has developed one – but multilateral and bilateral ICT strategies generally address development more generally, and may not even consider agriculture explicitly.[30] For example, USAID's Leland initiative had impacts on agriculture through its networking of agricultural researchers and NGOs (e.g.,ARPAN – African Rural Policy Analysis

[29] When one considers the price, quality, transport, and timing issues in agriculture, as well as the licensing concerns in several biotechnologies and the development of niche markets such as organics or shade-grown coffees, agriculture is actually quite information intensive. It is unlikely that "precision agriculture" will turn out to be the constraining factor to productivity improvements for small farmers, but the need to have information about production location and conditions follow agricultural products through the production and distribution chain will be crucial for helping smallholders capture the premiums that items such as specialty products command.

[30] Obviously organizations such as FAO, for whom agriculture is the central focus, are a special case, but there are relatively few such organizations in the donor community, compared to the number of bilateral and multilateral organizations. In the NGO community, however, there are more explicitly agricultural organizations, and these are where the prime examples of ICT applications in agriculture can be found.

Network) through its AfricaLink program, but the initiative itself was not considered an "agriculture" initiative. Similarly, existing ICT-and-agriculture projects occur within a donor organization's agriculture portfolio, but these projects may not be considered "ICT projects," even if they have incorporated ICTs as tools to achieve more traditional agricultural objectives, such as market development and facilitation. As a result, many organizations including USAID already possess ICT-and-agriculture experience, but a significant portion of the ICT experience may not have been explicitly recognized as agriculture and significant portions of the agriculture experience may not have been labeled as ICT. Together, this makes estimating the funding levels committed to ICT-and-agriculture activities difficult, since the data cannot be readily disaggregated in a meaningful way.

Table 3.1: ICT enhancements to agricultural programs – the four "C's"

Class of ICT enhancement	Typical Objectives
Connectivity and access	• Providing or enhancing rural connectivity through private or public telecenters and ISP promotion • Developing inexpensive access alternatives to traditional PCs , such as cell phones, pagers, and PDAs • Reducing the overall cost of information access in rural areas • Ensuring access to key intermediaries and stakeholders (e.g.,women, extension agents, community centers, etc.)
Capacity building through social networks and training	• Developing ICT training activities for key players such as agricultural policy makers, planners, researchers, extension agents, or other intermediaries such as community radio stations and NGOs • Using ICTs to enable or strengthen distance education and/or teacher support for agricultural education and rural communities • Creating virtual communities for both non-specialists and specialists • Linking productive value chains through web portals and ICTs
Content and application development	• Creating and stocking online digital libraries with new or repackaged digital material targeted at small farmers and community intermediaries • Producing new or adapted agriculture decision support tools targeted at agricultural users, particularly women, small farmers, and local intermediaries

Conducive governance and policy	• Policy advocacy, especially in the telecommunications sector, but also in commerce, agriculture, culture, and privacy law • Upgrading or establishing ICT capacity at national agricultural statistics systems and environmental monitoring systems • Creating investment funds and incubators for rural and agriculturally oriented ICT ventures • Tracking and dissemination of emerging uses and models for cost-effective ICT use

What can be done is to look at some of the projects that donor organizations have found successful and worth disseminating as "lessons learned" and models for the future, but it is important to bear in mind that these projects only represent accumulated experiences, mostly from pilots still in progress. They do not describe an overall ICT-and-agriculture strategy, even if these experiences could form seeds of one in the future. Virtually all donor organizations are at least examining the role of ICTs and knowledge management strategies in their project portfolios and planning to increase the attention given to them in future work. Until very recently, the donor environment with respect to ICTs can best be described as "cautious experimentation," with the possible exception of the World Bank, which has been bolder in its bid to become a "knowledge bank" as well as a "lending bank."

A. The World Bank

Although clear differentiation between donors and their roles has not yet evolved, a few simple observations stand out. The World Bank's Development Gateway project, probably the largest of the digital library/global repository efforts, is an attempt to create a "one-stop-shop" for development knowledge and expertise. The Development Gateway seeks to be more than a virtual library of development project information, the project also includes topic guides or mentor/librarians in issues such as agriculture and environment, discussion threads for specific topics and articles. To stimulate local content accumulation into the World Bank repository, the bank supports country gateways into its system run by independent local partners.

As the world's largest development donor, the World Bank is well positioned to take advantage of economies of scale to produce a large digital library accessible worldwide at relatively little cost-per-program, and it is open to contributions by non-World Bank contributors. Nonetheless, there is additional value to having sources of development information from multiple institutions, so one would hope that the development gateway would not be the only large source of development information available.

The World Bank also supports a variety of telecenter and public access activities, including venture funds for telecenter startups and mobile computing centers. For example, in rural areas where it is not practical to put computers in schools or where electricity is not available, World Links, an organization initiated by the World Bank, brings the technology to the students and teachers, by supplying a mobile classroom called the "Blue Bus". Inside the blue bus are

computers that can be run by generators as needed and are linked up to the Internet via telephone lines or wireless connection.[31]

B. Food and Agriculture Organization – Knowledge Management and Agriculture

The Food and Agriculture Organization is the world's largest public organization devoted exclusively to food and agriculture issues. Because its mandate is centered on agriculture issues, FAO's ICT planning considers ICT in agricultural issues more directly than most other multilaterals and donor organizations. FAO centers its approach on how knowledge systems and the flow of knowledge affect agricultural production and social equity. In an article entitled "Fighting Poverty with Information," FAO notes that there are no search engines "sensitized" to agricultural issues, and there is a need to develop appropriate metadata[32] to facilitate agriculture-specific information services.

FAO has established the World Agricultural Information Centre (WAICENT) as its strategic program for agricultural information management and dissemination. WAICENT acts as a clearing-house for information by establishing norms and methodologies for quality, standard categorization schemes, and implementing metadata for storage and retrieval. In addition, WAICENT takes an outreach approach by analyzing information needs of FAO stakeholders and the international agricultural development community, combining these analyses with best practices to meet those needs. Finally, WAICENT is seen as an intergovernmental forum to discuss issues and decide policies on information management through the Consultation on Agricultural Information Management (COAIM).[33]

FAO and others recognize that the digital divide has both technological and social dimensions and emphasizes that successful approaches must consider both. Improving content, content production, content management, and content delivery is considered a high priority goal, and is reflected in FAO's consideration of how to categorize and manage the new content which the community hopes to stimulate from bottom-up and participatory means. Important systems in development include Food Insecurity and Vulnerability Information Mapping Systems (FIVIMS) for policy makers, Virtual Extension Research and Communications Network (VERCON) for institutional strengthening, and FarmNets for community-level information systems.

FAO emphasizes the need for collaboration amongst international institutions to make knowledge sharing work effectively, and mentions UNDP, the ITC, the UN ICT Task Force, and DOT-Force as some important partners, as well as the World Bank and the CGIAR group.

C. Other Donors and International Organizations

In terms of specific strategies, both UNESCO and the CGIAR group are creating networks of researchers who are more likely than not to have an existing degree of ICT connectivity and high

[31] See report at: http://www.worldbank.org/worldlinks/english/assets/bigblue.pdf .
[32] Metadata is data that describes other data, for example, a bibliographic reference is metadata for the content (data) of a book, article, or web page.
[33] See: http://www.fao.org/coaim .

technology literacy. UNEP and other environmental organizations recognize that GIS is a fundamental tool for future planning, as well as the potential of handheld computing devices to serve as remote environmental survey and monitoring tools. UNIFEM and UNICEF cater to the needs of specific populations and emphasize the importance of ICT access for rural women and youth training. Multilateral organizations such as the World Bank, IDB, ADB, and AfDB tend to work more closely with country governments than do the bilaterals, who appear more experienced and better equipped to undertake projects that involve working directly with local communities. Multilateral development banks such as ADB and the World Bank have been investing in building statistical capacity within national ministries, including ministries of agriculture and natural resources. DFID has been noted for its policy of insisting that any software products developed with DFID funding be available for free or use open source licensing.

In short, most donors have been experimenting with a number of pilot activities to discover which approaches are most promising and give effective development returns on investment. On the whole, most donors have been experimenting with similar mechanisms – telecenters, digital libraries, training programs for organizations, and facilitating networks of experts, intermediaries, and stakeholders, etc.. To the extent that there is differentiation, the main factors affecting donors' ICT and rural development are: a) the overall size of a donor's budget, which affects the breadth, variety of approaches, and degree of risk it can take with smaller pilot projects, and b) specific characteristics of the population it sees as its principal clients and beneficiaries (e.g., researchers, women, the environment, a geographical region), which affect assumptions about the target beneficiary group, its ability to access and use ICT resources, and the appropriate technology bundles that will meet their needs cost effectively.

D. USAID Experience

USAID also has significant experience in ICT for development, including uses in agriculture. As with other major players in international development, USAID's early and largely successful work in ICT-enhanced development approaches has grown from the vision of individual innovators within USAID to increasingly broad efforts to develop ICT strategies that deliver development results in cost effective ways. This paper is part of that effort, executed under the dot-ORG cooperative agreement of USAID's DOT-COM alliance. USAID efforts include The Leland Initiative, AfricaLink, the Internet Center for Development, and the Internet for Economic Development Initiative (IED). In agriculture, a new effort, dubbed VOICE (Virtual Outreach for Information, Communication, and Education) is developing an "appropriate technologies" approach to information sharing and rural empowerment that focuses on practical applications of ICT in areas where the communities may not have ready access to the power, communications, or human infrastructure to support high-technology intense applications.

USAID has been active in supporting dissemination of location-based services such as Geographic Information Systems (GIS), Remote Sensing (RS), Global Positioning Systems (GPS), internet mapping and tracking. This represents a key set of activities in land use and

natural resources planning. Examples of USAID supported work that moves these critical applications forward are located at http://www.opengis.org/gisd/ and http://spatial-info.org/.

USAID's experience in ICTs for development is rich and crosscutting. USAID's website describes a number of ICT efforts at http://www.usaid.gov/info_technology . The scope of work for background paper and early directives from USAID requested an emphasis on the activities of other organizations, and so the present discussion of USAID's experience is necessarily brief. However, it is important to emphasize that USAID has programs and staff that demonstrate ICT vision and commitment, and that USAID has made and continues to make important contributions in the global effort to apply ICTs for the benefit of the poor and disadvantaged.

E. Major Agricultural Development Strategies and the Value of ICT

Since overall donor strategies in ICTs and agriculture are relatively similar, the best way to organize activities underway and important available opportunities is to categorize some of the main approaches to agricultural development and describe where the inclusion of ICT can and does add value. Many of the innovative uses are spearheaded by NGOs and organizations who draw their funding from several sources, including multilateral organizations, international organization such as FAO, private foundations, private sector companies, national governments and individual donors. Table 4.2 lists the broad strategies and accompanying ICT enhancements, followed by more detailed discussion of practical examples and – where appropriate – discussion of additional opportunities for ICT to add value to the existing strategy. The effectiveness of specific ICT enhancements will naturally depend on the policy, infrastructure, and human realities of specific rural communities, and is not necessarily appropriate for all circumstances in which USAID works, but all are appropriate for some situations, and many can apply in more situations than one would at first expect.

Table 3.2: Agriculture strategies and relevant ICT enhancements.
Note: only some examples are discussed in the chapter body. Others are cited in Appendix A

Agriculture Strategy	ICT enhancements
Improved agriculture, environmental, and food security planning	• Geospatial tracking, zoning, scenario planning, and simulation through Geographic Information Systems (GIS) (e.g., *environmental change detection through GIS and aerial imaging*) • Improved data gathering capacities through decentralized surveys aggregated through ICT data networks (e.g., *Voxiva's decentralized data system*) • Information systems and supply-chain-management software for drought, famine, and disaster relief (e.g., *Microsoft H.E.A.R.T. Software*) • Internet access, training, and web portals to link geographically separated planners for integrated development and relief planning.

Agricultural research and extension support	• Creating decision support tools for extension workers (e.g., *CGIAR/IRRI's "Rice Doctor"*) • Using ICTs to foster greater extension worker participation in agricultural research and setting research priorities (e.g., *FAO's VERCON*) • Facilitating ICT-enhanced virtual communities for local extension workers through websites and discussion groups (e.g., *FAO FarmNets*) • Connecting and training agricultural extension workers to use the Internet and appropriate ICTs (e.g., *FINTRAC market information training*) • [opportunity] ICT accessible networks of mentors and specialists to support agricultural extension workers (*similar to AskJeeves.com or AskMe.com*) • Web portals for agricultural research exchange and development (e.g., *CGIAR's InfoFinder portal*)
Rural and agricultural education	• Use of ICTs for agricultural and rural distance education (e.g., *Mexico's Telesecundarias*) • Creation of audio, audio-visual, and multimedia segments that can reach limited literacy populations (e.g., *EDC videodisks*) • Connecting rural radio to ICT networks to increase the availability of and improve customizability of local broadcast material (e.g., *EDC Multichannel Learning Center, WorldSpace Foundation*) • Remote support for rural teachers
Developing business opportunities for farmers	• Linking rural producers to global markets (e.g., *PinoyFarmer and eZiba trade site*) • [opportunity] Help create data standards that allow production information to follow products to consumer markets to take advantage of regional and production specificity (e.g., *shade-grown coffees, Identity Preserved white paper*) • ICT tools to extend rural credit and microcredit systems (e.g., *smart cards for microcredit*) • Use of ICTs to connect rural communities to expatriate and leverage migrant community resources abroad, including finance, mentorship, and role models (e.g., *Digital Partners' digital divide network in India and Africa*) • ICT access and training for of cooperatives, NGOs, and producer associations (e.g., *FINTRAC*) • Certification (e.g., *USDA online*)

Gender dimensions in agriculture	• Developing networks of women agriculturalists and extension officers (e.g., *AWLAE/ELN*) • Developing women-focused content to stimulate women's demand for ICT access (e.g., *ITWC's "Ideas for Making Money" CD targeted at women*) • Access provision for and training of women and girls in ICT use (e.g., *Winrock/USAID AWLAE*) • New business opportunities for women (e.g., *Grameen Telephone*) • Better publicity for female role models for both entrepreneurship and family care at women's sites
Improving rural governance	• Access to government services (e.g., *Brazil's Alvorada Project*) • Corruption control (e.g., *Seoul OPEN public procurement system*) • Land titling registries • Community resource management simulation and monitoring

The sections below describe many the activities and opportunities shown in table 4.2 in more detail.

1. Improved agricultural, environmental, and food security planning

Planning tools and systems for the agriculture sector are obvious areas where ICTs can add significant value. Planners in ministries and subnational government generally have a degree of infrastructure and human capacity that can support using traditional computing equipment, although in many cases training is necessary.

Geographic Information Systems (GIS) offer agriculture and natural resource management planners an increasingly

Mindinao Off-Grid Rural Electrification and ICT

This USAID and the Government of the Philippines program is a good example of the practical use of several different facets of ICT integration. GIS and spatial analysis tools augmented by aerial digital imagery, satellite images, and ground data are being used for planning project activities. The use of renewable energy is an entry point for improved access to information and communication technology (ICT) systems, ranging from simple rural telephony to lower-cost wireless connectivity options (e.g., e-mail, Internet) which can provide access to economically useful information, strengthen education, and reduce remote communities sense of isolation. VSAT connectivity is being piloted as by Winrock and CISCO NetHope Initiative. All of these enabling technologies are being used to promote economically and socially productive activities in Mindanao including agricultural processing, fishing, aquaculture, and livestock production and processing. The following information is being collected, collated and evaluated in the initial georeferenced databases: relevant demographic data on each sub-region, including density of population in the communities; poverty levels; literacy rates, child mortality rates; access to potable water and medical services; number and location of schools, health clinics, community centers, municipal government buildings or churches; land ownership patterns.

powerful way to plan for land use, track or estimate environmental impacts, visualize important social data, and compare different agricultural development scenarios. Agricultural and land use planners have used maps as a standard tool for years, but the ability of GIS to remake maps rapidly in response to new data or analysis allows planners new degrees of freedom in foreseeing and preventing disasters, or planning development scenarios.

Researchers at Clark Labs for Cartographic Technology and Geographic Analysis have performed in-depth change analyses of Normalized Difference Vegetation Indices (NDVI) imagery to better understand the spatial patterns of ENSO behavior (Eastman, et al 1996). Research using 14 years of publicly available AVHRR satellite imagery from the region indicates that there are patterns of movement over the southern hemisphere's summer months that might someday be predictable in their nature. This evidence engenders hope that greater understanding of the spatial character of ENSO events in southern Africa might aid with geographical planning of food security initiatives.[34]

Effective and responsible GIS use demands extensive data sets including detailed data gathered from multiple locations, each georeferenced (i.e. with location information) so that it can be mapped correctly by the GIS. Large data sets present a human and management challenge, but ICT systems can be deployed to aggregate such data from multiple sources, permitting distributed teams of surveyors to gather data and use the telephone, Internet, or PDAs to record and synchronize survey information to a central database. Some PDAs such as the Palm series or Handspring Visor can attach directly to Global Positioning Systems (GPS) that will stamp a latitude-longitude-altitude and time stamp directly into a survey for later synchonization to a central database. For example, CyberTracker, developed by a New Zealand software company, is free for non-profit or conservation use and is designed with a user interface suitable even for semi-literate populations. [35]

Voxiva, a for profit company, uses software in conjunction with the telephone system to collect and distribute data about agriculture and health. A user telephones to a set number, enters a code from a catalog or voice menu system and can dial to receive information about a product or disease. The system thus provides the user with information he or she requests and logs the call into an automated database, which can generate geospatial or other statistical reports. Presently Voxiva's system is being deployed for agricultural technical assistance in Peru and is also being tested as decentralized epidemic warning system for the United States.[36]

In addition, rural planners are prime candidates for ICT-enhanced strategies of professional networking and virtual communities, particularly for staff who might be more isolated in subnational and local jurisdictions.

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[34] Eastman, J.R., Anyamba, A. & Ramachandran, M. (1996) *The Spatial Manifestation of ENSO Warm Phase Events in Southern Africa* The Clark Labs for Cartographic Technology and Geographic Analysis Clark University, Worcester MA 01610 USA. *Veröffentlicht in: LORUP, E. und J. STROBL (1996): IDRISI GIS 96 = Salzburger Geographische Materialien, Heft 25. Selbstverlag des Instituts für Geographie der Universität Salzburg.*

[35] See: http://www.cybertracker.org , also http://www.cybertrackerworld.com .

[36] See http://www.voxiva.net .

GIS and Spatial Information in Promoting Sustainable Development As Part of Sound Environmental Management

ICT tools such as landscape scale spatial analysis increasingly are being applied to help balance the impacts of agricultural development with environmental priorities such as land and water conservation, biodiversity preservation through habitat preservation, fire management, and other aspects of improved land stewardship in an agricultural context. Expansion of this aspect of USAID funded programs has great potential for measuring, monitoring and understanding the dynamics of agricultural activities (whether smallholder scale or agribusiness) and resultant environmental impacts.

There is a wide range of applications of ICT spatial survey and analysis tools relevant to USAID, for example in

- Determining land suitability for highest agricultural production at minimal environmental and social costs;
- Watershed planning;
- Mapping rural landscapes for sustainable resource use;
- Planning and assessing infrastructure to minimize environmental costs,
- Tracking environmental and socioeconomic changes and impacts over time,
- Vegetation and biodiversity analysis;
- Monitoring compliance with selective logging regimes and forest laws;
- Certification of agricultural and forestry practices (for example shade-grown coffee or chocolate);
- Quantifying and valuing non-traditional sources of revenue for farmers in the form of eco-assets - for example carbon sequestration.

Spatial Information Packages (SIPs) are built on geographic information system (GIS) database structures populated with detailed data layers including geography, digital elevation models, socioeconomic data, vegetation, land use and land cover and other program relevant data sets. These Spatial Information Packages are data rich analytical foundations upon which USAID and its partners can base detailed site analyses, planning and simulations, program impact measurement and monitoring and advanced resource survey and analysis. The spatially referenced data layers within a SIP allow project managers, technical staff, partners, and beneficiaries to visualize the scope and impacts of a project in ways not otherwise possible. Everything from large country scale georeferenced datasets to more localized topographical and thematic maps provide context within which to frame the factors affecting project plans and measures. Various types of satellite imagery, along with true-color or multi-spectral aerial digital imagery can be incorporated as additional data layers for reasonable cost. This varied array of remote sensing data provides a view of the landscape in far greater detail than what traditional maps can provide, all the way from landcover classifications at broad scales, to measurement of individual trees or furrows with high-resolution videography.

A SIP can be a valuable tool for monitoring and evaluation, especially when used in conjunction with before- and after-project aerial digital imagery, acquired according to the needs and timing of the management cycle. Data tables incorporated into the background of a SIP can be interactively queried on the map; for instance if one was to overlay the results of a sociological survey of a village with aerial digital imagery of that village, one could click on an individual house seen in the imagery in order to learn about the demographic data collected, and compare changes over time as a result of project activity.

Geographic Information Systems augmented with ground, aerial, and remotely sensed data are used as a key component of spatial analysis, measurement, and monitoring programs. Despite the availability of satellite data over several decades, practitioners have found that the coarse resolution and two-dimensional nature of satellite-based sensing data when used alone has limited its usefulness in assessing and monitoring many of the kinds of processes and indicators useful to USAID. Alternate approaches, which overcome many of the disadvantages encountered by the use of satellite imagery alone, are now available. These new approaches grew out of a need to identify features such as rural roads, small land holder activities and selective logging that were not visible in satellite imagery and a need to analyze forest and landscape structure at a level of detail and consistent measurement that could not be achieved with the conventional use of 2D satellite imagery alone. One new approach for example is based on a portable multispectral camera system (matched to Landsat bands 1 to 4) that can attach to local aircraft and produce

high-resolution digital imagery (meter to sub-meter per pixel range) in a 3D coordinate GIS space where both vertical and horizontal measurements can be made utilizing multi-scale data sources (ground, air, space) for ecosystem analysis and monitoring. These methods of acquiring and analyzing statistically valid metrics of the landscape within a spatially explicit model have been demonstrated to be within an acceptable cost/benefit ratio.

2. Agricultural research and extension support

Computers, CD-ROMs, the Internet, PDAs and telephones are prime mechanisms for empowering and supporting rural extension services, many of whom find themselves squeezed by decentralization, diminishing public funds, and privatization of public services at the same time that agriculture becomes more information intense. Extension workers represent major sources of knowledge and best practice information for the communities they serve, but they themselves require accessible knowledge resources in understandable and affordable terms order to function effectively.

The CGIAR/International Rice Research Institute's (IRRI) "Rice Doctor" in an example of an ICT based decision support tool which is presently accessible as an Internet based service but could easily be made available on CD-ROM, PDA, or even paperback to extension agents off of the communications grid in rice cultivating areas around the world. The Rice Doctor is a diagnostic tool for identifying pests, diseases, and other problems in rice production.

IRRI's Knowledge Bank includes many other ICT resources for rice cultivators and their support systems, including e-learning modules, regional GIS maps, and materials to support training courses. For more examples, see http://www.knowledgebank.irri.org .

In strengthening research-extension linkages, ICT may also offer networking and social mechanisms to help the agricultural research community stay focused on the needs of rural farmers. FAO's Virtual Extension Research Communication Network (VERCON) model plans to use ICTs as tools to manage agricultural research agendas through a participatory stakeholder process that includes researchers, extension, NGOs, and small producers. VERCON is still in its initial stages and is notable for its explicit emphasis on how the technological and social networks interrelate and support each other.[37]

FAO's program to develop FarmNets plans to use ICTs to stimulate peer-to-peer support and mentors for extension officers, farmers, input suppliers and others. The goal is to empower extension officers by building support services, virtual communities, and other ancillary services for mutual support and knowledge sharing.

3. Rural and agricultural education

Successful farming and agriculture require skill, and as local economies are forced to adapt to global exposure, rural education is increasingly important to keeping the rural poor both

[37] See FAO WAICENT: "Fighting Poverty with Information," web: http://www.aptsec.org/seminar/meeting-2002/digital-op/ICT-01-Mr.Riggs-FAO.doc .

nourished and employed. At the same time, many rural schools operate tenuously, some relying on untrained or volunteer teachers necessarily disconnected from pedagogical training or dominance of the subject matter. ICTs are by no means a panacea for the general crisis in rural education, but they can offer help in some cases.

Mexico's Telesecundaria program uses television materials broadcast or recorded onto VHS to support secondary (and in some cases primary) education in rural zones. The video covers the same material as the standard secondary school curriculum, managed by a local teacher who presents learning materials and follows with exercises completed locally. About 60% of Telesecundaria teachers are fully qualified teachers and 40% are university graduates who receive induction training. The model has been so successful that several Central American countries (e.g., Guatemala and Honduras) have signed agreements with the Government of Mexico to replicate the model. It has also influenced much video-education in other parts of the world, such as the TV educativa efforts in Brazil.[38]

In the early 1990s, the Educational Development Center (EDC) developed interactive videodisk technologies in partnership with engineering universities in India to teach field skills, communication skills, troubleshooting and technical assistance. Videodisks had hypertext and other interactivity, where students could walk through decision trees and other educational scenarios to take part in simulated experiential learning and travel. The videodisk technology proved an excellent pilot, but was difficult to scale up because the videodisk technology never gained wide acceptance in the consumer market; however, contemporary DVDs offer similar degrees of interactivity and are now widely available and at considerably lower prices than videodisks ever were.[39]

ICT for agricultural education faces the same basic issues that characterize all ICT strategies – a need for connectivity, capacity building, and content development, supported by conducive governance. Simple repackaging of broadcast and other didactic content into new digital forms for rural is one activity which can leverage the power of ICTs quickly, provided there solutions to access challenges, but the really new opportunities come from the interactive potentials of ICT systems, which can often compensate for gaps in a human instructor's specific subject matter dominance. With modern software and computing equipment, much educational content development for ICTs can be done inexpensively, but content is usually costly *to do well*.[40] Nonetheless, low reproduction costs for digital materials means that the cost of good digital content development can be spread over a large number of beneficiaries.

ICTs can benefit rural education in four important ways, each requiring progressively more support in infrastructure and human capacity building.

[38] Winrock International and TeleCommons Development Group, 2002. "Rural Connectivity and Energy Initiative," p. 53. Report prepared for the Inter-American Agency for Cooperation and Development, Organization of American States, July 3, 2002.

[39] EDC's website is: http://www.edc.org .

[40] Well executed content development requires exceptional care in the treatment of subject material and attention to audience needs and perceptions. In addition, high quality content development requires usability testing and adaptation – a phase frequently skipped in response to deadline and budget pressures.

- ICTs providing teacher materials and curriculum support in agriculture
- ICTs as an additional skill or subject matter for students in the classroom
- ICT as enrichment for existing courses, offering new pedagogical approaches
- ICT for rural distance education

Rural radio and interactive rural radio have played important roles in rural development, awareness building, and education. Community radio stations represent key intermediary organizations for whom Internet and other ICT accessibility (e.g., access to CD-ROM libraries of agricultural programming, linked to keyword searches) will allow radio stations to be more responsive to rural needs, provided that the social networks and incentives (e.g., linking to virtual communities in extension and agricultural research) are also in place.

ICTs and Biotechnology

Biotechnology is one of many innovations that are taking root in the developed world that may be made more accessible, understandable, and more appropriate to developing countries through the use of ICT. The potential benefits of genetically modified pest protected, saline tolerant, nutrient enhanced and drought-resistant plants are enormous. Commercialization of genetically modified (GM) crops is occurring rapidly. However, the speedy introduction of these crops is subject to considerable debate. In contrast to knowledge about higher yields at lower costs, knowledge about the potential long-term impact of GM crops is less well developed because it is not driven by strong private financial incentives. Given the vast importance of the agricultural biotechnological revolution for food, energy, human health and the environment, as well as the polarized views on the adequacy of existing regulatory systems, the need for information sharing and informed decision making is great. ICT in itself will not solve the conflict of opinions. However, it can contribute greatly to the increase of knowledge – particularly in USAID assisted countries and among target groups – by facilitating communication and public debate among scientists, advocacy groups, private companies, and policy makers. It also will help farmers and consumers to make more informed decisions.

EDC's multichannel learning center has managed interactive radio programs in Haiti, Zambia and other locations to teach reading, mathematics, and other subjects to improve the quality of primary education. The Zambian program includes life skills training into each program, given that the target audience has many aids orphans and similarly distressed populations.[41]

4. Developing business opportunities for farmers

USAID's approach to agricultural development in recent years has increasingly focused on helping small farmers develop their operations as small businesses and take advantage of global trade opportunities by inserting themselves efficiently into the larger agribusiness sector. In this regard, creating mechanisms for small farmers to access, learn about, and contribute to the information networks that integrate global agribusiness is not only useful, but absolutely essential for USAID's strategy to work.

Supporting ICT systems and training that link small producers to markets and provide technical support and guidance to enter higher value markets is one strategy. The Philippine Ministry of

[41] See: http://www.edc.org/mlc/ .

Agriculture's PinoyFarmer project,[42] executed by Winrock International, takes this approach, as does eZiba's portal to deliver artisan products from developing countries directly to US consumers.[43] At Independent Sector's annual conference in 2001, eZiba reported their clients receiving up to 400% increase in the price of their products.

PinoyFarmer and eZiba show how ICTs can assist farmers in capturing price gains from niche markets. Thinking systemically, there are important opportunities for developing data mechanisms to allow producer information to follow products through the system. A white paper on agricultural information tracking needs in the US is available on the web from IdentityPreserved, which considers both specialty crops and genetically modified organisms (GMOs).[44] Ensuring that systems exist to track environmental and production information (e.g., organic certification, sustainably harvested fish or forest products, and labor friendly production) products as they move through the entire global production chain will be key to fostering markets for sustainably and ethically produced products that can support sustainable development. Information alliances with supermarkets who track inventory with ICTs (e.g., Fresh Fields, Safeway) could allow both businesses and consumers to monitor the social and environmental effects of their consumption, including cost effectiveness of environmental consumerism.

Access to ordinary and micro-credit is increasingly seen as an essential strategy to promote business development in rural areas, including both farm credit and credit for off-farm activities. ICT systems, including computers, portable devices and "smart cards" are supplementing the information infrastructure that allows credit agencies to extend deeper into rural areas, produce credit risk/return profiles rapidly, and help both borrowers and creditors keep track of their repayment status and obligations (see sidebox on rural credit)

ICTs offer new income opportunities for rural families who have relatives in cities or abroad. In their study of Grameen telephone use, the Telecommons Development Group in Canada reports that facilitating financial remittances from urban relatives and those abroad was one of the main uses for cellular telephones: justifying even costly international calls.[45] In some towns in rural Mexico, remittances from the United States are the largest single contributor to municipal GDP, and local politicians must also communicate and campaign with migrant family members in New York,[46] and ICTs are likely to play an increasingly important role in managing both the politics and economics of rural life for such communities.

In India, the NGO Digital Partners created an ICT mediated network to help Indian expatriates in the United States and Europe facilitate remittances, become venture investors and mentors to IT and other industries in India. In July 2002, Digital Partners launched the Digital Divide Network

[42] See: http://www.pinoyfarmer.com .
[43] See: http://www.eziba.com/StoreFront/about .
[44] See: http://www.identitypreserved.com/handbook/white01-01.htm .
[45] http://www.telecommons.com/villagephone/section1.html .
[46] Smith, Robert C., 1964-. Los Ausentes Siempre Presentes: The Imagining, Making and Politics of a Transnational Community between Ticuani, Puebla, Mexico and New York City, Robert Courtney Smith 1995

for Africa with the support of the United Nations ICT task force to replicate this model for African development.[47]

Agricultural cooperatives, NGOs, producer associations, and input suppliers are all key intermediate organizations with some degree of purchasing power or aggregation, and can serve as facilitators who connect local people to new resources. FINTRAC, a for profit company selling market research, information, and technical assistance services has developed a program which leverages local partners to equip and train local organizations and governments to take advantage of market linkages and information services such as their own.[48]

Microfinance and ICT - Johanna Gregory, Winrock International

Access to credit is extremely important to farmers. Rural financial services and microfinance are being redefined by the development of new technologies, which aim to decrease transaction costs and increase reliability and security, allowing financial providers to manage greater numbers of clients faster, more efficiently and more effectively. Many rural financial institutions are starting to use automated teller machines (ATMs), "smart card" operations, and other new technologies.

In 2000, with support from the World Bank's Consultative Group to Assist the Poorest (CGAP), Indian microfinance institution (MFI) Swayam Krishi Sangam (SKS) developed a smart card technology for microfinance providers, which would allow lenders and borrowers to track loan activity electronically, replacing manual passbooks, collection sheets and loan ledgers. From the field, loan officers use hand-held terminals (HHTs) enabled with microloan-processing software to record client data, take applications and make loan calculations, and then upload the data into the central database back at the office. One read-only HHC is left in the village to allow members to check their account information. SKS is currently in the process of developing and testing software that links the Smart Card to its MIS and accounting packages.

ACCION International, a well-known microfinance provider network, uses Palm Pilots to streamline its lending process and reduce costs. Studies have shown that it typically takes one hour per client to gather data in the field and re-enter it by hand into the central computer. Using the new technology, this time reduces to 15 minutes. The Palm Pilots can also be equipped with GPS and used by loan officers to locate clients. ACCION affiliate Compartamos in Mexico has been field testing the technology since June 1999.

The Indian microfinance provider BASIX uses a similar smart card system it calls BASIXPOT (BASIX "point of transactions"), which acts like an identification card and electronic loan book. BASIXPOTs have been set up in three rural areas of Andhra Pradesh, where BASIX has found that the new technology helps them recruit and process new borrowers three times as efficiently and at two-thirds the cost.

The Foundation for the Promotion and Development of Microenterprise (PRODEM), a Bolivian MFI, recently instituted a system of multilingual ATMs, operated by smart cards and a fingerprint scanner, which allow savings account holders to conduct financial transactions at their own convenience and with unprecedented security. The ATMs offer both written and spoken instructions in Spanish or one of the two predominant indigenous languages, Aymara and Quechua. Prodem makes the smart cards available to their account holders for $10, with an additional $7 annual operating charge. Prodem builds the machines for $15,000, less than half the price of standard ATMs. Other major Latin American rural banks, such as Bancafe (Columbia) and Banrural (Guatemala) are looking into the system.

Sources:

[47] See: http://www.digitalpartners.org
[48] See: http://www.fintrac.com

BBC News, "Smart Money Goes Multilingual," Business, June 13, 2001, http://news.bbc.co.uk/1/hi/business/1386310.stm.

Beebe, Christianna, "Palm Pilots: Lending Efficiency to Microcredit," *InterAction*, January 17, 2000; http://www.microfinancegateway.org/cache/palm.pdf.

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Gupta, Subodh Kumar, "Information and Communication Technology (ICT) Plus Finance Model for Rural Poor," June 2002, http://www.alternative-finance.org.uk/rtf/sudamasmartcard.rtf.

Swayam Krishi Sangam (SKS), Smart Cards and Microfinance, Achievements to Date, http://www.sksindia.com/achievements.htm.

5. Gender dimensions to rural agriculture

The women in development community has been quick to recognize the value of ICT in meeting women's needs. It is also important to take the gender dimension of ICTs seriously from the earliest point possible, when gender norms about the new technology and its use are still forming. Winrock's African Women's Leaders in Agriculture and the Environment program, funded by USAID, the Ford Foundation, and anonymous donors took an early initiative in networking women leaders into an electronic professional support network – ELN (Electronic Learning Network) – in order to build a cadre of women agriculturalists who could go on to influence policy and introduce gender perspectives into the male-dominated agricultural policy community. These women support each other by maintaining contact through email and informing each other of events through listservs to avoid isolation as a woman in a predominantly male environment. These women can also serve as electronic mentors to young girls who show promise in agriculture or policy circles.

As with other areas of ICT enhancement, accessible and relevant content is important for addressing the gender dimension. Winrock's ELN activities includes a CD-ROM in French and English that walks a woman through project development challenges and day-to-day leadership for change skills, such as writing a letter, making a budget, and coping with negative stereotyping. The International Women's Tribune Centre (IWTC) and International Development Research/Eastern and Southern Africa Office (IDRC/ESAO) have developed a CD-ROM designed to be accessible to low-literacy women who have access to a computer through a telecenter or job. The CD-ROM uses a simple browser navigating system with graphic interface and spoken text. Topics covered include building on assets, making money from a product or service, and expanding opportunities.[49]

In societies that constrain male-female interaction and which also handicap women's educational opportunities, the effort to pass appropriate agricultural, health, or other information to women can be exceedingly indirect. ICTs may in many cases allow women to access information they require through a computer or cell phone, rather than have to interact directly with a man.

[49] See: http://www.comminit.com/Materials/sld-5477.html

Additionally, if certain crops and varieties (e.g., vegetables for home consumption) are considered primarily a "women's crop," important extension information may not be available locally but could be available on the Internet.

Finally, the Grameen telephone experience shows that ICTs can open new opportunities for women to raise family incomes through off-farm activities. The eZiba experience also found that women could improve incomes considerably through artisanal activity now made profitable by ICT linkages to more and higher paying distant markets.

6. Improving rural governance

Rural areas have traditionally been some of the most service-poor and neglected zones in rural governance and administration. ICTs can help reduce the effects of isolation and transport costs, and create mechanisms for greater accountability. Governance applications of ICT include:

- Training and support for local governments with new roles following decentralization
- E-Governement assisted by or accessed by Internet or CD-ROM
- Access to government programs targeted at a specific region
- Local land titling registries
- Community resource management and monitoring
- Improved transparency

ICTs permit decentralized decision-making by allowing information to be shared inexpensively among dispersed decision makers. Local governments and community organizations not only gain access to development programs via ICTs but can also contribute input to program design. ICTs may help promote participatory mechanisms for citizens and transparent management of local resources by elected leaders by keeping track of public records available to all. It also can facilitate civic education campaigns and the implementation of national development projects. A positive example of how ICT has helped local communities is the creation of community information centers under Brazil's Alvorada Program, an effort of national, state, and local governments. Winrock implemented this program in Bahia, one of Brazil's poorest states.

Working in 73 communities Winrock helped develop 73 locally managed access centers. By six months, 365 children had gained scholarships, eleven schools had received photovoltaic energy systems, one senior citizen group was established, one sanitation project was designed (by the community), one community garden was developed, two children libraries were started, one artisan cooperative was founded, three dairy trainings were held for 45 people in hygienic cheese production and more than a hundred new jobs were created. The USAID supported renewable energy commercialization program in Brazil provided technical assistance and training and in so doing leveraged the Brazilian investment (in the community information centers and photovoltaic equipment), and is indicative of the potential for future USAID activities.

In Seoul, South Korea, the creation of an online municipal procurement system, OPEN (Online Procedures ENhancement for civil applications) has become an international model for improved transparency and reduced bribery in local government procurement. The system reduces the

need for individual meetings and telephone calls in procurement, opens the process to a larger number of bidders, and records the interactions, which are facilitated by at least two officials in order to reduce the opportunities and incentives for corruption.[50] The OPEN system in Seoul was produced for a large urban center, but adapted strategies could improve governance in rural areas as well, particularly if open to networks of intermediary associations, such as NGOs.

[50] See the World Bank's discussion of OPEN in Seoul: http://www1.worldbank.org/publicsector/egov/seoulcs.htm. See also commentary from a design participant: http://www.fnfkorea.org/fnst_eng/localauto/changon1.htm.

CHAPTER IV
LOOKING TO THE FUTURE: RECOMMENDATIONS TO USAID

As USAID's global strategy once again emphasizes the role of agriculture, it is both fitting and imperative that USAID consider the new role that ICTs can play. In industrialized countries, ICTs have led to many changes in agriculture since it was last a major priority at USAID. ICT deployment in industrialized countries has in some ways changed the vision of what a "developed agricultural system" looks like and calls on responsible agricultural development assistance to take these new dimensions into account in setting objectives and assessing impact. In other areas, such as food security, the presence of ICTs dos not change overall objectives, but they do offer tools for meeting them in a more cost effective and transparent way.

This chapter offers recommendations to USAID as it considers ICT opportunities in to its new agriculture strategy. These recommendations fall into three main classes:

- *Project design recommendations in agriculture and ICTs*
- *Increasing EGAT/AFS capacity to support missions in ICTs*
- *Pilots and additions to present activities for each new agriculture strategy*

A. Project Design Recommendations in Agriculture and ICTs

Considering the important dimensions of ICT and agriculture, the activities underway by major development organizations and donors, and the agriculture sector's "future directions" document, this study recommends the following five approaches to ICTs in USAID's agriculture project portfolio:

- *Empower agricultural and rural intermediary organizations* through ICTs;
- *Improve rural access to ICT*-based knowledge, services, and social networks through telecenters and alternative models of access points;
- *Develop and adapt relevant agricultural content for digital dissemination* in local languages and at a technical level appropriate to rural communities and organizations;
- *Ensure that women and girls can participate effectively* in knowledge societies and ICT use; and
- *Use ICTs to strengthen community feedback mechanisms*, democratic decentralization, and track community ICT uses as they evolve.

USAID should also pursue some policy-oriented activities in close partnership with multilateral organizations: targeted policies include telecommunications policies to open up telephone and Internet connectivity, especially in rural areas; trade policies to reduce the cost and increase the availability of ICT equipment and software; intellectual property protection for software vendors and to ensure that community knowledge remains in the public domain; and privacy policies to

ensure that civil liberties and democratic life can prosper in the new environment. Many of these policies fall into the domain of non-agricultural ministries and agencies; a USAID policy strategy would encourage agricultural and natural resource management ministries to build support for these in other ministries. At the national level, the recommendation is that USAID should work primarily through multilateral organizations. At more local levels, where appropriate, USAID can take a leadership role, but in consultation with appropriate multilaterals.

1. Empower agricultural and rural intermediary organizations

In discussing the Agricultural Knowledge System, intermediary organizations such as NGOs, producer associations, local extension agencies, and others proved to be the lynchpin connecting the knowledge available in a farmer's local knowledge system and that available in the global system. The single best way to leverage the impact of ICT availability and the Internet is to build the capacity of local organizations that work with farming families to see themselves as knowledge brokers. The most obvious capacity building activities for such organizations would include helping them connect to the Internet and other ICT-based services (such as CD-ROM libraries) and providing training on electronic research and communication techniques. Depending on the existing capacity of any one organization, training would progressively cover:

- Training individuals to use ICTs;
- Training organizations in ICT planning and organizational strategies involving ICT;
- Creating networks of peer institutions, virtual communities, and mentors.

To become effective knowledge brokers, however, intermediary organizations will need to master three additional skills above and beyond searching ICT libraries and the Internet. Together, these would allow them to perform the knowledge system and knowledge brokering roles outlined chapter 1, figure 1.2. A fully capable intermediary will be able to:

- *Contextualize global knowledge* so that it applies to the realities of the local community. This may involve a translation of material into less technical language, or the addition of information about local conditions (e.g., soil types, market conditions, etc.)
- Pro-actively *assess and articulate present and future information needs* of clients, including *feedback on the availability of and usefulness of locally accessible knowledge*.
- *Provide objective feedback to national and global knowledge sources*, which may include the *production of locally developed content on lessons learned*, preferably developed through participatory methods.

As USAID works to empower community intermediaries with ICT, it should bear in mind that a diversity of organizations with access to information is important to ensure the democratic and equitable representation of USAID clients. With available funds always scarce relative to the total need, there will frequently be tensions between the need to provide at least some connectivity to as many locations as possible and the need to avoid creating local information oligarchs that use a local monopoly on information to distort markets and politics to create advantages for themselves.

As prices drop, more small farmers and their families may be served directly by information services and ICT access in various forms, the availability of relevant content expands, and local needs become more apparent. It is important to **leverage intermediary organizations to help design the access models and information services that local users will require**, so that future services will be developed in partnership with those professionals closest to their communities and with the best understanding of their needs and realities.

2. Improve rural access to ICTs

Even with an intermediary-based ICT strategy for agriculture, creating sustainable rural access is a formidable challenge. The main options for improved connectivity are to support multipurpose rural telecenters and to invest in developing services that can be delivered by smaller, less expensive devices such as PDAs, telephones, pagers, and cell phones. We recommend that USAID support both approaches in tandem, depending on the applicability of each to a country's specific agricultural goals.

In both telecenter and alternate connectivity strategies, successful and sustainable access depends on the ability to **aggregate uses for ICTs in order to maximize the value** they provide to a community of clients. This approach seeks to increase willingness to pay for access by providing as many useful services on the same equipment to as many clients as possible. In many cases, this will imply having to partner and coordinate with a health or education project, or a local entrepreneur, to share the costs of access provision and maximize available synergies.

Near-term: Telecenter strategies

Telecenters and cybercafés have a poor sustainability record. Still, they are often the main option for useable connectivity, which is why many governments, NGOs, and donor agencies continue to invest in telecenter development and support.[51] Therefore, USAID needs to use **strategic filters** when using an approach that relies on telecenters for agricultural goals. Such filters acknowledge:

- Telecenters are a means to agricultural ends, not an end in itself
- Telecenters survive best when they are multi-use, so partnerships with other USAID sectors, other donors, and commercial interests to support a specific telecenter will increase the likelihood of sustainability
- Local leaders frequently support telecenter development and may be able to leverage additional resources to create and sustain local telecenters
- Telecenters that also provide voice communication services tend to last longer

In the near-term, many ICT strategies in agriculture are likely to depend on telecenter or telecenter-like approaches because most will use web or CD-ROMs as dissemination methods to provide information and knowledge services to rural areas.

[51] The World Bank expects to publish shortly a best-practices document reporting on the applications and sustainability results of several multi-year pilots of rural telecenters.

Long-Term: Piloting Alternate Connectivity Models

USAID should **pilot ICT access alternatives to telecenters**, such as information services that can be accessed by cell phones, PDAs, pagers, and inexpensive web-enabled devices. This includes developing software applications or server-based ICT services that can serve information requests on these more accessible devices. As with telecenters, access to equipment is merely a means to an end – the ability to move communications and knowledge through the agricultural information system to people that require it is the ultimate goal.

If multi-use telecenters represents USAID's short-term strategy for improving connectivity and access, pilots and replications of services delivered on alternative devices represents a strategy that prepares for long term impacts in rural ICT access. A sample project would merge the Grameen telephone strategy with Voxiva's voice menu system for disseminating agricultural prices or key weather information.

3. Develop and adapt relevant agricultural content for digital dissemination

Relevant content that adds value to rural communities and smallholders is what ultimately drives demand for and the sustainability of ICT access methods. Content includes information in documents and on websites, audio and video media, decision support tools, software, and services to facilitate communication and commerce.

Digital content produced in the 1990s by both private and public sector organizations tended to have a more literate, technologically connected, and economically privileged audience in mind. The private sector developed content for those with access and purchasing power; the university and public sector developed content for those with access and specific training. Much presently available digital content for agriculture addresses issues relevant to small farmers, but not in forms that rural users can use.

We recommend that USAID programs invest significant resources in **adapting or repackaging existing content** for use by rural users and intermediaries. In many cases, research results from national agricultural research services (NARS) and other fora are too academic to guide even intermediary organizations. Programs that create or reinforce partnerships between intermediary organizations and agricultural research institutions to produce accessible content in local languages and at the appropriate technical level will satisfy most community content needs, but success depends on intermediary organizations being the major partner, manager, and evaluator of the process.

USAID should support "**participatory content development**," as a method, merging participatory methodologies with content development activities. In the participatory content development model, local intermediaries convene rural farming groups to identify and rate the type of information they need, then go about finding it, creating it, distributing it, and readapting

it in response to comments. These groups may contract agricultural researchers for technical support in content development, but community intermediaries ultimately own the product.

The beauty of the participatory content development model is that it meets several development objectives simultaneously: it identifies gaps in needed content, develops it in language and terminology accessible to target users, increases demand for rural ICT access, builds individual and organizational ICT skills in rural communities, and strengthens the capacity of communities to engage in democratic dialogue and contribute to regional and global knowledge societies. In many cases, the content is likely to retain its value to users long after a project's closeout.

We recommend that future USAID support to research institutions (e.g., CGIAR centers and CRSP universities) be contingent on the development of partnerships between these research institutions and intermediate service providers that already have or are likely to be able to develop the capacity to repackage and adapt research results.

4. Ensure that women and girls can participate effectively

It is easy for well-intentioned programs to assume that women and men will benefit equally from ICTs deployed in agriculture, but the history of agricultural development shows that agricultural and other assistance programs can easily overlook women's needs. Women need to be an explicit focus for connectivity, capacity building, and content development approaches to ICT in rural areas.

This study notes a particular gap in developing **ICT content for rural women**. Content and applications are crucial because they drive demand for ICT and information services. Without content that addresses women's needs, evaluations may erroneously conclude that women are uninterested, unable, or unwilling to take advantage of ICTs, even when they have access to connectivity and training to use it. The absence of content that addresses women's needs can reduce overall demand for ICT services by as much as 50% or more, threatening the sustainability of access centers. Content for rural women might include information on supervising children in the field, health, and technical support for subsistence and vegetable crops, which are typically managed by women.

Ensuring women's participation includes taking action in the other areas recommended here, such as **prioritizing work with intermediary organizations with women staff in meaningful positions** and organizations that have the capacity to work with and understand women's needs. Telecenters supported with USAID funds should have locations or hours where women can work in a relaxed and unthreatening environment, and training for women by women instructors, particularly in cultures that carefully control women's interactions with men.

Considering the gender associations attached to specific technologies (e.g., computers versus telephones) can help ensure that women have access to and can contribute to the information they need. Focusing on access to information and communication needs, rather than to specific pieces of equipment, will help make women's participation in development more transparent and productive.

5. Use ICTs to strengthen community feedback mechanisms

The greatest qualitative change that ICTs offer the agricultural development community is the opportunity to **increase feedback to and from rural areas**. ICTs can be more interactive and responsive to the needs of those who use them than traditional broadcast-type technologies. Planners engaged in rural development understand that problems exist with a technology push and information dissemination approach which lacks a feedback component, but the expense and challenge of collecting feedback from geographically dispersed sites has traditionally made it difficult for even well intentioned planners to move away from one-way information broadcast models without exploding budgets.

Various tools for obtaining feedback were discussed earlier, and include paper and electronic surveys, website hit counts, discussion fora and weblogs, databases, email, and several others. However, the greatest impediment to incorporating feedback in projects is a lack of **up-front planning for community feedback processes**.

We recommend that any agricultural development project with a substantial information technology component **be explicit about the manner by which feedback will be obtained and used**. Digital technology allows for new, faster and cheaper feedback mechanisms, and such mechanisms must be piloted further and applied. Impact indicators for any content development or repackaging work should **measure how frequently content is updated and modified in response to user feedback**, and note the number of end-user requests for additional content.

B. Actions that Increase EGAT/AFS Capacity to Support Missions in ICT

USAID has already begun to use ICTs in several agriculture programs. However, USAID is only now beginning to implement an overall integrated strategy for ICTs in agriculture. To bring these efforts together under a unifying vision, USAID can begin immediately with a few processes to jump-start the integration of ICTs as part and parcel of normal project planning, execution, and monitoring. Such actions would:

- Support the development of region- and country-specific ICT strategy documents
- Provide an annual report to missions on key ICT uses in agriculture
- Develop an agency-wide rapid rural ICT assessment and evaluation methodology
- Identify local or regional teams of rapid mobilization ICT-agriculture specialists

1. Support the development of region- and country-specific ICT strategy documents

The variety of policy, cultural, technological, and human capital conditions USAID missions encounter can create difficulties in establishing an institution-wide strategy for ICTs and agriculture. ICT-enhanced activities that have significant development impacts in South America may prove technologically inappropriate for much of Sub-Saharan Africa, or culturally

unacceptable in the Middle East. There are two dangers here: first, success in one region may lead to overconfidence in the prospects of similar activities elsewhere; second, a particular ICT strategy that fails in one region may be abandoned in others where it is more likely to succeed.

These difficulties have stalled the development of regionally appropriate ICT strategies and techniques at other organizations. To help USAID avoid these pitfalls, EGAT/AFS should support mission efforts to design up their own agricultural ICT strategies, leveraging the regional bureaus to draw up regionally appropriate priorities and targets. The present document could be used as a background document or base strategy from which to build and specify country or regionally specific needs. Planning and roll-up activities are always an iterative process, but the planning itself is central to mainstreaming realistic considerations of where ICTs will add value.

2. Provide an annual report to missions on key ICT uses in agriculture

Even today, the price, power, and flexibility of ICTs change so quickly that no analysis can hope to capture more than a snapshot of a rapidly evolving field. Remaining on the leading edge of ICT applications will require USAID to make an ICT-agriculture applications and best practices report available for ready use by missions. This report could be produced in collaboration with other donor agencies, updated on an annual basis to reflect current and emerging uses and trends around the world. Such a report would include.

- A catalog of new and existing ICT tools in agriculture, updated annually to capture emerging uses and technologies
- An analysis of changing and emerging user needs, predicated on the understanding that end-users will identify unexpected value-added uses for ICTs once they become familiar with them.[52]
- Emerging equity, gender, and intellectual property issues.
- A "field handbook" of inexpensive ICT interventions that can help project managers and designers find quick and inexpensive ICT strategies to improve their project impact or management.
- Cost and management templates for ICT options at a variety of connective and electric scenarios, so that project planners can understand the impact of ICT components on project budgets and management plans.

3. Develop an agency-wide rapid rural ICT assessment and evaluation methodology

As both a planning and monitoring-and-evaluation tool, USAID needs to develop or adopt a rapid ICT assessment methodology tailored to its agriculture strategy. Such a methodology will permit a team of project specialists to enter an active or proposed project zone and quickly evaluate the opportunities and challenges to ICT use and potential ICT enhancements. A rapid ICT methodology would take into consideration several key factors, including:

[52] Although economists, agronomists, and ICT specialists could write such a report, technolophilic anthropologists are frequently the quickest to identify new and unexpected uses for ICTs.

- The availability and cost of electricity and communications networks;
- Existing human capacity to utilize and/or maintain a variety of ICTs;
- Value of existing digital content for project success;
- Value of new digital content which could result from the project;
- Feedback mechanisms enabled by ICTs and the degree to which they are used;
- Equity dimensions of ICT utilization, including the gender dimension;
- Value of ICT to efficient project execution and new content development;
- Budget and management implications of proposed digital ICT approaches;
- Cost increments over alternative non-digital ICT strategies;
- The sustainability of ICT investments past project end; and
- Supportive or complicating effects of the surrounding policy environment.

The methodology would quickly identify useful ICT interventions and project increments that could improve project impacts in line with USAID's new directions in agriculture, feed more rapidly into an archive of lessons learned, and become a standard tool for ICTs in both project planning and in monitoring-and-evaluation phases. For EGAT/AFS to benefit fully from such a methodology, it would have to consider a variety of device and connectivity options for truly remote and off-grid areas.

4. Identify local or regional teams of rapid mobilization ICT-agriculture specialists

As a complement to the rapid ICT assessment methodology, a registry of known teams of rapid-mobilization ICT specialists will assist EGAT/AFS in project needs assessments, ICT opportunity identification, cost evaluation, and implementation issues. In some cases, teams would need to be physically deployed at project sites to help with implementation issues. In other cases – particularly where existing ICT capacity meets sufficient minimums – they could operate remotely, via a distributed technical assistance network.

C. Pilot Projects and Continued Program Development for EGAT/AFS

ICTs naturally complement USAID's new agriculture strategy. Given the impact that new ICTs can have on agricultural development, the authors suggest specific ICT activities linked to each of the four themes outlined in EGAT's "New Directions in Agriculture" document.

1. Mobilizing Science and Technology for Agriculture

Donors and international organizations such as CGIAR and FAO already support virtual networks to improve collaboration between agricultural scientists and speed the dissemination of applied agricultural knowledge (e.g., IRRI's Internet library[53]; FAO's WAICENT) among highly qualified agricultural researchers. Many of these virtual libraries and their associated networks are – in theory – also available to community intermediary organizations that have access to the

[53] See: http://ricelib.irri.cgiar.org

Internet. In practice, however, it can be difficult for intermediaries to locate and access material that responds to specific local needs and which is phrased at the appropriate technical level.

We recommend that USAID partner with organizations developing virtual networks and add value by piloting activities that increase their openness to feedback from community intermediary organizations who may not have extensive academic credentials. Such a pilot would bring together intermediaries along with virtual network host organizations and reputable web service design firms (or computer-assisted learning firms) to develop digital content that answers frequently asked questions posed by intermediaries and responds to them in culturally and technically accessible language. Intermediaries might visit and become part of the host institution for a short period with the goal of sorting through frequently asked questions and preparing useful answers with text or multimedia tools that could later be placed in a technical support services library or on a CD-ROM. The key to making such a partnership produce valuable material is to keep the intermediary organization in the content driver's seat, with the network host organization and web service firm as supporting resources.

Agriculturalists frequently lament a perceived disconnect between agricultural research materials and extension work. One challenge has been the difficulty of managing feedback from rural consumers of agricultural research. With ICTs, opportunities for feedback have increased, but entities must still adapt their organizational cultures to value and support client feedback. By facilitating the type of partnerships above, where intermediaries might spend a short time at an international host institution, USAID can increase the capacity of global knowledge sources to meet requests from rural intermediary organizations in a responsive and effective way, informed by current agricultural research and, perhaps, helping tie the agricultural research agendas at host institutions more closely to the needs identified by the intermediaries.

2. Developing Trade Opportunities for Farmers

Today's ICTs provide the coordinating infrastructure for regional and global trade. Our recommendation is that USAID focus efforts on developing country and/or regional commodity portals (i.e. vertical portals or "vortals") for key agricultural commodities in target locales. These portals will have web pages and databases that allow the actors in the agricultural value chain to locate each other, negotiate prices and quality, coordinate logistics, find technical assistance, arrange legal support for contracting, and other information services vital to empowering smallholder trade (e.g., Brazilian cashew growers' portal). In addition to a website, these commodity portals would offer instant messaging, listserv, and other software options so that as many services as possible can be coordinated through cell phones, pagers, or ICT equipment other than PCs. Regular usability testing and incorporation of user feedback into the portal design will be essential components of the strategy.

To build exposure and increase use of commodity portals, connectivity efforts under this activity would focus on piloting Internet connectivity options at local marketplaces. Marketplaces are social locations where large number of farmers gather, information is at a premium, and potential users are most likely to absorb the value of ICT services by demonstration. Consideration of gender will require selecting marketplaces where women also gather, or nearby health and

household centers. Gender balance also means developing a virtual network for food and vegetable crops in parallel, since these crops are most frequently cultivated by women.

Capacity building under this pilot will focus on empowering rural producer associations to use the commodity portals and to learn to make requests for services that may not presently exist, so that portal maintainers (most probably a local management organization, NGO, or national producers' association) can improve the portal design in response to feedback.

3. Bridging the Knowledge Divide

Agricultural extension services have traditionally provided technical assistance to bridge the knowledge divide between institutionalized knowledge sources (e.g., universities and international research centers) and local farming communities. Today, shrinking budgets, government decentralization, and the arrival of private actors in technical assistance all underscore a worldwide reduction in local extension capacity. In the face of a declining extension service, USAID can lead in bridging the knowledge divide by piloting *new models of distributed technical assistance* that focus on building the capacity of local NGOs, input suppliers, extension agents, and producer associations to work together and act as effective knowledge brokers for their clients.

A Distributed Agriculture Network for Smallholder Empowerment (DANSE) would train the above intermediaries in knowledge management and knowledge brokering skills for their local knowledge systems. In addition to training in PC, Internet, CD-ROMs, and other ICT use, knowledge broker training would include how to identify new clients and client needs, and how to execute follow-up evaluations that address the effectiveness of their brokering services. The system should find ways to reward network participants for contributing new solutions and innovations to a regional "lessons learned" database of stories and offer web or other tools for designing solutions.

DANSE network members will be linked into a virtual network by a portal site or sites which include text messaging and cell phone options for accessing some of its information services. The portal would provide access to mentors along the lines of askme.com or askjeeves.com. To facilitate field visits, particularly for extension agents and NGOs, the design should permit network members to store questions, answers, and contact info on PDAs, and explore the possibilities of inexpensive digital cameras, PDA-cum-camera, or cell-phone-cum-camera devices to assist in disease diagnosis or results monitoring.

A distributed technical assistance pilot should run in several countries simultaneously, allowing an intensive evaluation to compare the factors leading to success or failure and identify the most successful facilitating ICTs in the model before attempting to scale up. As a multi-country pilot, a global NGO or contractor with significant in-house analytical capacity would probably be the ideal coordinating organization. Partnering with FAO (potential linkages with FAO's VERCON program) and a global management organization is also an option, particularly if USAID can direct its efforts to drive forward the feedback and participatory content development aspects of the pilot.

4. Taking the Long Term View

USAID has already established a portfolio of ICT investments for long term natural resource planning in support of "location based" information services such as remote sensing, Geographic Information Systems (GIS), Global Positioning Systems, Internet mapping, and others. Our recommendation is that USAID continue to provide leadership in what many consider the fastest growing area of global information systems. USAID has already established strategic collaborations with the CGIAR group and the EROS data center, which has promoted policy documents essential to promoting "location disaggregated" data that can feed GIS-enabled approaches to policy and long-term natural resource management.

USAID has supported the MyCOE (My Community, Our Earth)[54] site, which provides education and outreach on the use of geographic and modeling tools to describe and model community resource uses. Along with continuing USAID's policy work to support geospatial technologies in natural resource management work, pilot projects that could bring the MyCOE methodology to schools, municipalities, and producers associations in regions on the frontier of digital connectivity (i.e. communities just barely able to connect to the Internet). Adaptation of the methodology for use via CD-ROMs on stand-alone systems – to the extent practical – will also raise local awareness of natural resource management issues, particularly if combined capacity building for local resources monitoring. Geospatial data has especially strict requirements for data quality, which tends to make it expensive, but increased local capacity to provide that data will both offer income opportunities to community organizations and tend to lower data costs for global users of geospatial data.

D. Conclusions

EGAT/AFS is leading with vision by commissioning an agricultural strategy explicitly recognizing the critical roles that ICT can play in meeting agricultural priorities at USAID. Planning is the key to making cost effective ICT investment decisions, whether in agriculture or any other sector. Capturing the range of opportunities that ICTs enable is an enormous challenge, but eased by the concept of a smoothly functioning agricultural knowledge system that works to ensure that smallholder families can access information and knowledge they need, when they need it, in a language they find accessible and via mechanisms that permit feedback, choice, and empowerment. The starting point is to build awareness of agricultural information and other items that can drive demand for access to services, taking advantage of newly available feedback mechanisms give farmers a voice in the creation new services or improvements that can help them make more productive and sustainable decisions. Just as ICTs have transformed developed country agriculture, they are transforming agriculture in developing counties, but the changes underway are not necessarily identical. The rural poor will feel the effects of global information networks and global knowledge systems, many will find ways to access it, and the recommendations presented here will help USAID ensure that such access is ultimately empowering for the rural poor who are the principal beneficiaries of EGAT/AFS's efforts.

[54] See: http://www.geography.org/sustainable

APPENDIX A:
OVERVIEW OF ORIGINAL SCOPE OF WORK

This document has evolved significantly since the original scope of work was developed in April 2002. The initial scope of work set out base themes to be covered and a process for putting the document together. Following the definition of the scope, the Academy for Educational Development (AED) and Winrock International designed a preliminary outline which was sent to USAID via the dot-ORG officers of the DOT-COM[55] alliance. After the outline approval by EGAT/AFS, focus groups were held with key USAID/Washington personnel in AFS. A draft paper was produced for a discussion at a two-day workshop in October 2002. Comments and suggestions from USAID were then incorporated into a revised version delivered to USAID in January 2003 and finalized in February 2003.

In relation to key themes for discussion, the original scope of work included the following text:

"Information and communications technologies are becoming increasingly important in all sectors of international development assistance. One challenge surrounding the use of ICTs is determining how best to integrate these technologies to increase the impact and sustainability of development programs. To address this challenge, USAID agriculture and development (EGAT/AFS) staff have asked the dot-ORG project, which is part of USAID's DOT-COM initiative, to prepare a provocative planning paper. This paper explores high impact strategies for integrating ICTs into USAID's agricultural development activities. It aims to support strategic planning on the integration of ICTs in agriculture programs and assess how best to leverage the benefits of ICTs to improve impact, results and sustainability. The ultimate goal of this paper is to help USAID develop a cross cutting strategy for integrating ICTs in agricultural development activities across the Agency.

It should address:

- Process for generating agricultural science and technology knowledge through the use of information technology.
- Current uses of ICTs in agriculture and natural resource management and an assessment of the positive impacts of these uses, weaknesses and strengths, and costs and benefits.
- How ICTs can affect USAID's main areas of activity and be effective for the user through 1) delivering effective science and technology to improve agriculture, and 2) bridging the knowledge gap between poor farmers and agriculture research organizations.
- What peer donor organizations such as IDB, the World Bank, the Asian Development Bank, other US Government agencies, and other major bilateral organizations are doing with respect to ICTs in agricultural development.

[55] The DOT-COM (Digital Opportunity through Technology and Communication) program is a five-year umbrella program with three interrelated associate awards each focusing on a major area of ICT development, policies and regulations, access and applications, and education and learning systems.

- The importance of integrating women into information technology (IT) and agriculture programs and strategies for ensuring gender equity.
- Current and future areas of greatest potential impact with respect to five main areas:
    - Governance - enabling and empowering rural populations;
    - Developing global trade opportunities for farmers;
    - Mobilizing science and technology, especially biotechnology, for use by poor farmers;
    - Promoting sustainable development as part of sound environmental management; and
    - Bridging the knowledge gap, especially for women farmers, via training, outreach, promotion, and adoption of research results at local levels."

Structure of the paper and how it addresses the defined scope

The final document has four chapters. The first chapter defines ICTs, gives a context for ICTs in agriculture and rural development, and sets out an analytical framework – the agricultural knowledge system – for linking the enormous variety of ICT applications to agriculture. Chapter two discusses the challenges to using ICTs in rural areas, including financial sustainability, technical challenges, and some emerging technologies which may provide value. Chapter three offers an illustrative survey of projects and approaches currently underway by USAID's peer institutions and other important players. Finally, chapter four presents recommendations to USAID/EGAT/AFS on next steps and approaches that capitalize on USAID's existing work and will strengthen its role as an innovative leader in agriculture and ICT.

Referring back to the themes in the original scope of work, this paper has discussed how networks of researchers, intermediaries, and end users supported by ICT communications, decision support tools, and knowledge repositories can facilitate the process of generating agricultural science and technology knowledge through the use of information technology. The application of knowledge management and knowledge brokering concepts to support research dissemination and feedback is central here.

Our discussion of applications and illustrative examples, particularly in chapter three, has offered an inventory of current uses of ICTs in agriculture and natural resource management. In many of these applications, it is still too early to arrive at definitive assessments of their success, although the strengths and weaknesses of these approaches has been covered to the extent practicable. It is important to remember that these conclusions are highly context and time-bound: costs of ICTs and applications are changing rapidly, with many technology costs dropping over time while the benefits of using ICTs increase with time in many circumstances.

Discussion of ICT mediated professional networks, distributed technical assistance, mentor networks, virtual communities, decision support tools, and distance learning has emphasized how ICTs can deliver effective science and technology to improve agriculture. In addition, the focus on empowering rural intermediary organizations is essential to bridging the knowledge gap between poor farmers and agricultural research organizations.

Chapter three of this study has offered an illustrative analysis of what peer donor organization such as the IDB, the World Bank, the Asian Development Bank, other US Government agencies and other bilateral organizations are doing with respect to ICTs in agricultural development. In many cases, donors are supporting similar approaches and applications, and so the description of activities categorizes them by the agricultural problems they address, rather than the donor organization sponsoring it.

This study discusses the importance of integrating women into information technology (IT) and agriculture programs and strategies for ensuring gender equity in each of the major sections. It finds that ICTs are both critical to empowering women for more effective agricultural development and that women are critical for making ICT investments sustainable by providing an increased market for ICT services. One of the principal conclusions of this study is that ICT efforts in rural areas must ensure that women and girls can participate effectively and equitably in emerging knowledge networks.

In specific areas, this paper concludes that ICT has important impact potentials in:

Governance: principally through the delivery of e-government services, information and training for local government officials, and the improvement of government transparency and accountability.

Developing global trade opportunities for farmers: through market information and facilitation, distributed technical support networks to meet international quality standards, and greater access channels to higher value markets.

Mobilizing science and technology, especially biotechnology, for use by rural farmers: linking intermediaries to knowledge networks via ICTs will be the optimal strategy for leveraging science and technology for rural farmers, particularly if information can also connect to financial resources and technical support as these technologies are introduced.

Promoting sustainable development as part of sound environmental management: training planners to use geospatial and information tracking technology to monitor sound environmental management will be the most direct ICT contribution to this goal. In addition, helping environmental impact information follow products through the international value chain can develop a more sustainable commerce. Finally, best practice repositories can track practical ways for rural smallholders to produce in a more environmentally sustainable manner.

Bridging the knowledge gap, especially for women farmers, via training, outreach, promotion, and adoption of research results at local levels: a phased approach to ICT development, targeting intermediary organizations first for connectivity and capacity building, inserting such organizations into evolving knowledge networks, leveraging their knowledge to identify ways to reach farmers directly, and finally develop service and access mechanisms for small farmers is the fastest way to move forward. To ensure a gender sensitive approach, women's meaningful participation in such intermediary organizations is a critical factor.

Because the paper is envisioned as a tool to stimulate discussion, debate, and creative strategizing, the dot-ORG team has sought to make it thought provoking, not just descriptive and technical, as well as practical to USAID staff and others engaged in agricultural development. The team has also sought not simply to present the current state of agriculture and ICTs, but to look to the future to evaluate trends, emerging technologies, and new opportunities as requested in the original scope of work.

APPENDIX B:
RELEVANT REFERENCES AND WEBSITES

This section lists references and websites that were used in the document text, as well as additional references that are relevant to the topics discussed. For easier browsing, this appendix is organized into the following thematic sections:

- *Background Documents and Lists of Sample Activities*
- *Food and Agriculture Organization Activities*
- *Other Large Institutions and Knowledge Libraries*
- *Telecenters and Community Computing Center Approaches*
- *ICT Use in Market Facilitation and Trade*
- *ICT Applications in Rural Microcredit*
- *Grameen Telecom*
- *ICTs Beyond the PC*
- *ICTs, Education, and Distance Education*
- *Low-literacy Applications*
- *Networking, Mentorship, and Technical Assistance Applications*
- *Other Applications and References*

Some references fall into more than one category, depending on the context of discussion. This sample list

Background Documents and Lists of Sample Activities

http://www.usaid.gov/info_technology/
USAID's website tracking major USAID efforts in the area of ICTs and development.

http://www.worldbank.org/poverty/voices/globcoal/webguide/ict.htm
World Bank's Global Coalitions for Voices of the Poor Web Guide for Information and Communication Technology (ICT), identifying organizations, efforts, and global coalitions to bring ICT and empowerment to the poor. The guide does not focus exclusively on agriculture or even rural development, but includes these areas. The list shows some USAID funded projects, including AED's LearnLink.

http://www.ifpri.cgiar.org/2020/focus/focus07/focus07_06.htm
Appropriate technology for sustainable food. IFPRI recommendations for agriculture-oriented ICT investments.

http://www.ifpri.org/pubs/books/ufa/ufa_ch40.pdf
Chapter from an IFPRI publication discussing the digital divide and benefits of ICT accessibility for rural communities and agriculture.

http://www.identitypreserved.com/handbook/white01-01.htm
White paper published by the IdentityPreserved organization, which creates products designed to help track the production methods, origin, and other key pieces of information attached to agricultural products so that agricultural commoditization does not strip products of information that can increase or decrease its price in the market. This white paper addresses the issue of information tracking on specialty crops and crops produced with biotechnologies.

http://www.fao.org/Gender/en/educ-e.htm
FAO report on women, gender, and education, containing useful statistics on women's importance in agricultural productivity, on the knowledge resources available to them, and the global benefits of improving knowledge services available to women.

http://learnlink.aed.org/Publications/Gender_Book/Home.htm
USAID/WID funded analytical study by the Academy for Educational Development on *Gender, Information Technology, and Developing Countries*, addressing the status of and recommendations for addressing women's needs and the gender dimensions of ICT and ICT-enabled projects.

http://www.apqc.org/free/whitepapers/whatiskm.pdf
World bank white paper on knowledge management and development.

http://www.orgchange.org/
http://www.orgchange.org/whatsnew.htm
New activities at the Organizational Change program in the CGIAR group.

Food and Agriculture Organization Activities

http://www.aptsec.org/seminar/meeting-2002/digital-op/ICT-01-Mr.Riggs-FAO.doc
FAO WAICENT document on "Fighting Poverty With Information," discussing the role of information and knowledge in poverty reduction.

http://www.fao.org/WAICENT/FAOINFO/SUSTDEV/EXdirect/EXre0027.htm
FAO's March 2000 strategic vision on Agricultural Knowledge and Information Systems for Rural Development.

http://www.fao.org/waicent/index_en.asp
World Agricultural Information CENTer (WAICENT) portal of the Food and Agriculture Organization. This site seeks to bring digital agricultural content to a single portal location, using a Yahoo!-like organizing structure.

http://www.un.org.tr/fao/FIVIMS.HTM
Food Insecurity and Vulnerability Information Mapping Systems website. FIVIMS is a collaboration led by FAO to apply Geographic Information Systems (GIS) to creating national

early warning and mobilization for food security threats. FIVIMS also seeks to link these national mapping systems into a global system for addressing food security.

http://www.fao.org/coaim/index_en.htm
Website for FAO's Consultation On Agricultural Information Management (COAIM). COAIM is a biennial meeting that brings together policy-makers, funding agencies and major players in all the relevant fields of agricultural information, as well as observers from the United Nations and the non-governmental organization community. COAIM serves as a global framework for the normative work of FAO's World Agricultural Information Centre (WAICENT), addressing objectives of the World Food Summit Plan of Action

http://waicent.fao.org/tour/tour/Demos/vercon/default.htm
Demonstration website with concept papers and presentation information describing FAO's Virtual Extension Research and Communications Network (VERCON), which envisages virtual support networks linked by ICT to serve the needs of agricultural extension workers.

http://www.fao.org/sd/2001/KN1008_en.htm
Website on FAO's FarmNets concept, presented in March 2001 and piloted in Uganda

Other Large Institutions and Knowledge Libraries

http://infofinder.cgiar.org/
Federated libraries between CGIAR, FAO/WAICENT, and Future Harvest Centers designed to disseminate research findings to relevant virtual communities.

http://www.developmentgateway.org/
Website of the Development Gateway organization, launched by the World Bank in partnership with other development donors and the private sector. The Development Gateway seeks to facilitate knowledge management, experience and knowledge sharing among organizations working in development. It is organized by development themes, including agriculture, and has form sections led by thematic and regional moderators, as well as a library of published materials. At present the library is highly technical in nature, but will likely to begin to include items for populations closer to the ground.

http://www.knowledgebank.irri.org/
Library website for the International Rice Research Institute, including several web based services, including prototype distance education services on rice-related topics, prototype virtual tools for extension work, and rice recipes. Note the "rice doctor" selection which takes the user through a series of diagnostic questions to suggest a solution to rice diseases and pests.

http://www.cabi.org/
CAB International's website. CABI has produced extremely useful databases of agriculture, forestry, and biodiversity species information which may form one component of a content base serving a distributed extension and rural agriculture support system.

http://crsps.org/
Website of USAID sponsored Collaborative Research Support Programs (CRSPs). These programs leverage US expertise at land grant universities to provide research support and dissemination to partner organizations (usually universities) in developing countries, and particularly in Africa.

http://forms.sc.egov.usda.gov/eforms/default1.htm
The US Department of Agriculture's online forms service also contains business development services to promote small business development, find housing, and secure credit.

http://www.fas.usda.gov/
The Foreign Agricultural Service (FAS) website of the USDA also includes links to exporter assistance programs, development and training opportunities, import programs, and trade data to facilitate business linkages between US agricultural exporters, foreign importers, and vice versa.

Telecenters and Community Computing Center Approaches

http://www.col.org/telecentres/Telecentres_complete.pdf
Latchem, Colin, and Walker, David (eds.). *Telecentres: Case studies and key issues. Management, Operations, Applications, Evaluation*. Vancouver, Canada: The Commonwealth of Learning. Perspectives on Distance Education Series. 2001.
Evaluation of several telecenter approaches primarily in the context of distance education.

http://www.nytimes.com/
Lee, Jennifer 8, " In China, Web Revolution Means Games ," New York Times, 29 June 2000. "The Net May Promise Change, but Young Chinese Just Want to Frag Their Friends."
Article describing the contribution of video game revenue in supporting private for-profit telecenters in China. The article text is also reprinted in the weblog at:
http://pub18.ezboard.com/fbalkansfrm9.showMessage?topicID=9.topic

http://www.shirky.com/writings/half_the_world.html
Discussion of the "half the world has never made a phone call" statistic, and how it is overused, misleading, and probably no longer even accurate.

http://www.cid.harvard.edu/ciditg/papers/Kirkman%20JHD%20article%20final.doc
Kirkman, Geoffrey S., *Out of the Labs and Into the Developing World: Using Appropriate Technologies to Promote Truly Global Internet Diffusion*. Harvard University, Center for International development. March 2001.
Discussion of aggregate benefits of Internet access in developing countries and how some alternative equipment approaches may help address financial sustainability challenges.

http://www.comminit.com/pdf/CKS_Guide_to_ICTs_for_Development.pdf

Center for Knowledge Society's *Guide to ICTs for Development*, published in 2002, discussing how ICTs help empower rural communities with a focus on South Asian applications. An excellent selection of sample projects underway in India, including several pages on Agribusiness.

http://www.presidencia.gov.br/projetoalvorada
http://www.energia.org/resources/papers/wssd_latinam_regpaper.pdf
http://www.winrock.org/fact/facts.cfm?CC=5366
Information on Brazil's Portal do Alvorada Project, which creates community information centers with a small number of ICTs in extremely poor municipalities in Brazil's Bahia state. It provides an innovative example of how governments, funding organizations, and NGOs can work together to provide rural connectivity. Users frequently report developing new uses for the centers, which bode well for their sustainability after the project ends in 2003.

ICT Use in Market Facilitation and Trade

http://www.pinoyfarmer.com
Statistic websites are now giving way to dynamic websites driven by connections to online database. One example is the PinoyFarmer price database.

http://www.laneta.apc.org/anec/
Website of Mexico's National Association of [field producer] Commercializing Enterprises (ANEC) (in Spanish), which shows an example of a regional association's role in developing information services. ANEC has a subscription service that regularly sends national market prices via fax to local marketplaces in Mexico.

http://www5.prossiga.br/caju/index.html
Website (in Portuguese) of a Brazilian vertical portal linking producers and associations in the cashew value chain. To translate, search for the site through Google and select "translate this page."

http://www.eziba.com/
The eZiba website links western consumers to artisans and their products in developing countries, generating additional income and higher prices for local products through connections to global markets. Many of the products sold through the eZiba site come from rural areas, representing off-farm income opportunities for rural communites.

http://www.fintrac.com/
Websit for Fintrac, a global organization that facilitates agricultural trade through the provision of timely market information. Fintrac's primary mission is to increase the productivity and sales of its clients sustainably. This frequently involves incorporating small-scale producers into local, regional and global supply chains through innovative technical interventions in the field, as well as market analysis and linkages with commercial buyers.

ICT Applications in Rural Microcredit

http://news.bbc.co.uk/1/hi/business/1386310.stm
BBC News, "Smart Money Goes Multilingual," Business, 31 June 2001.

http://www.microfinancegateway.org/cache/palm.pdf
Beebe, Christianna, 'Palm Pilots: Lending Efficiency to Microcredit," *InterAction*, 17 January 2000.

http://www.gfusa.org/newsletter/spring01/index.shtml
Grameen Foundation USA, "Reducing Micro-Credit Costs Through Information Technology: The Case of SKS," *Grameen Connections*, Spring 2001.

http://www.alternative-finance.org.uk/rtf/sudamasmartcard.rtf
Gupta, Subodh Kumar, "Information and Communication Technology (ICT) Plus Finance Model for Rural Poor," June 2002.

http://www.sksindia.com/achievements.htm
Swayam Krishi Sangam (SKS), "Smart Cards and Microfinance: Achievements to date"

Grameen Telecom

http://www.grameen-info.org/
Website of the Grameen Bank in Bangladesh, which provides microcredit loans and other services to impoverished communities, with special emphasis on women. The site sections on Grameen Telecom and Grameen Phone are particularly relevant for their work in helping women entrepreneurs start and manage their own businesses selling ICT services, particularly rural telephony services.

http://www.telecommons.com/villagephone/contents.html
http://www.telecommons.com/villagephone/section1.html
Telecommons Development Group report on the use of Grameen Phones in Bangladesh. Section 1 of the document notes that rural telephone users made extensive use of telephone availability to facilitate financial remittances from family abroad, creating demand for seemingly expensive international calls.

http://www.oneworld.org/ips2/aug98/14_23_053.html
OneWorld article discussing the impact of cell phone business run by rural women and the role of the Grameen Bank.

ICTs Beyond the PC

http://www.villagepda.com/
An inexpensive handheld computer designed to operate inexpensively. Balancing act reports that the Nairobi based Environmental Liaison Centre International and San Jose, California based MediaSolv have developed software solutions for the VillagePDA to be used to help coordinate fishing activities around Lake Victoria and prevent overfishing. They expect the PDA to be available to fishing communities for under $25.

http://www.simputer.org/
Website of the Simputer Trust, an organization which has developed a handheld computer to deliver information services to rural communities with low income and semi-literate populations. The computer has been designed to handle rural conditions and sell at a price below $200.

http://support.earthlink.net/support/TUTORIALS/CHAT/chat_tips_bots.jsp
ISP Earthlink description of chatterbots or "spam bots" which are artificial intelligence computer programs designed to advertise products. Some are designed to be helpful and respond to frequently asked questions. In combination with instant messaging and/or short message text services, such "bots" could be useful for providing technical assistance through cell phones and pagers, among other things. For example, the SmarterChild bot on the AOL Instant Messenger system can answer questions about local weather, movie times, etc. by adding SmarterChild to a buddy list, and asking a question.

http://itmatters.com.ph/news/news_07162002a.html
Local Filipino information technology site describing the magnitude of Short Message Service (SMS) use in the Philippines and trends as Multimedia Messaging Service options begin to appear on the market.

http://www.voxiva.net/
Voxiva is a company that develops telephone based information technology systems. Small farmers in Peru have used Voxiva's voicemail systems to save on long distance telephone calls to input suppliers, markets, and contractors in Lima and other urban centers. Voxiva's system can also deliver information through telephone menuing systems, which are useful for distributed health services and other applications.

http://www.cybertrackerworld.com/
http://www.cybertrackerworld.com/applications.shtml
User site for CyberTracker, a software application designed for low power PDAs to permit collection of GPS waypoints for integration into GIS and community mapping applications. The software was designed to provide a bridge between traditional Bushmen trackers and modern wildlife managers and researchers. It has been released as free software for conservation uses, and inexpensive share-ware for commercial applications.

http://www.freeplay.net/
http://www.freeplay.net/newsite/product/product.html
Website of FreePlay, an organization that merges their hand-crank, spring, and solar PV technologies with standard products to produce devices (flashlights, radios, and potentially PDAs

and other ICTs) that can operate in regions where electricity and reliable battery supplies can be difficult to find.

http://www.farmradio.org/
Website of the Farm Radio Network, a network developed in partnership with IDRC and which broadcasts and receives some of its content through the WorldSpace satellite system. We're a Canadian-based, not-for-profit organization that gathers and researches information about practices that farm families find helpful. They produce radio scripts in print and electronic format, and distribute them free of charge to approximately 500 Network radio partners, 800 community workers, and organizations engaged in agricultural extension and rural development.

http://www.worldspace.com/ (commercial)
http://www.worldspace.org/ (foundation)
WorldSpace and the WorldSpace Foundation run a geosynchronous satellite system that presently covers Africa, most of Asia, and soon to cover Latin America (through a new satellite launch). These satellites enable users in to download substantial quantities of digital content through relatively inexpensive (<$100) receivers on a free or subscription basis, regardless of land-based telecommunications capacity. The broadcast is presently one-way only, but the bandwidth is substantial and can deliver multimedia broadcasts or audio for telecenters or digitally enabled radio stations.

http://www.vita.org/
Website for Volunteers in Technical Assistance (VITA). VITA uses Low Earth Orbit (LEO) satellites to pass text and web information to extremely remote communities. The satellites do not provide a constant Internet connection, but permit short transmissions several times per day. VITA has also set up a portal to help manage volunteers and technical information.

ICTs, Education, and Distance Education

http://www.world-links.org/english/
http://www.worldbank.org/worldlinks/english/
Website of the World Links organization, an NGO partnering with the World Bank, and the World Links section ICT for education website at the World Bank Institute. WorldLinks seeks to bring ICT enhancements to education programs in developing countries. World links focuses on access enhancement and capacity building, but also addresses content and policy issues as necessary.

http://www.worldbank.org/worldlinks/english/assets/bigblue.pdf
World Links, an organization initiated by the World Bank, brings the technology to the students and teachers. World Link supplies a mobile classroom called the "Blue Bus".

http://www.unesco.org/education/educprog/lwf/doc/portfolio/abstract8.htm
http://www.iadb.org/sds/doc/Edu&Tech12.pdf

UNESCO and IDB documents on Mexico's Telesecundaria program, designed to provide ICT support to underserved regions (including rural areas) to improve the quality of secondary education. Models that explicitly include agricultural education for rural farmers could link with education initiatives on similar models.

http://www.aed.org/publications/TechnologiesForEducation/TechEdChapters/10.pdf
Comparison of Mexico's Telesecundaria program and Brazil's TV Educativa's Telecurso 2000. These two case studies conclude that in mid-size and large countries, television at the secondary level works: it can be used to reach underprivileged groups, either rural children or young adults who have left schools. It is likely that the learning described above is equal to or greater than at conventional schools. Costs are lower than the equivalent requirements (e.g., setting up full schools in rural areas or fully operational, four-hour-long "night schools" in urban areas).

Low-literacy Applications

http://www.iwtc.org/181.html
http://www.comminit.com/Materials/sld-5477.html
http://www.un.org/dpi/ngosection/Women%20in%20Africa%20Using%20ICT.ppt
Information on the development of a practical CD-ROM for use at rural community telecentres in Uganda entitled: "Rural Women in Africa: Ideas for Earning Money." The CD was produced by International Women's Tribune Center (IWTC) in partnership with Media One, Kampala and IDRC/Acacia Project, Nairobi. The CD is designed in a multimedia format to be accessible by illiterate or semi-literate women in rural areas and empower them by generating ideas in which they make and manage money for the household.

http://www.tarahaat.com/
Technology and Action for Rural Advancement website, produced by the Development Alternatives Group in India. This site is a prototype portal designed for use by low-literacy populations. Sections of the website speak to the user as the user points to parts of the website. The site is designed to provide development information and services for a typical Indian village, accessed through a kiosk or telecenter.

http://www2.edc.org/mcl/
http://www2.edc.org/mcl/projects/countries.asp
Educational Development Center's multichannel learning center, which specializes in utilizing text and non-text methods of educational instruction to improve educational results. EDC's MCL efforts include interactive radio courses for remote and underserved teachers in Ethiopia, Guinea, Nigeria, Tanzania, Zambia, Egypt, Haiti, and Honduras, as well as a pan-Africa program and a global program.

Networking, Mentorship, and Technical Assistance Applications

http://www.askjeeves.com/

http://www.askme.com/
Examples of global websites designed to match people with questions with people who can answer them. Questions can range from psychological support to highly technical matters.

http://www.winrock.org/what/volunteer/volunteer.cfm
Winrock International's Volunteer Technical Assistance Program. This program is already highly web-enabled, allowing prospective volunteers to locate assignments that fit their skills and geographic interests. Volunteers frequently stay in touch with the communities they visit, and some have continued to volunteer services electronically after their assignments end.

http://www.digitalpartners.org/
http://www.digitalpartners.org/africa.html
Website of Digital Partners, who use digital ICTs to provide venture capital and mentor support to ICT-enabled entrepreneurs and NGOs in developing countries. Digital Partners launched its Digital Divide Network for Africa, which borrows its successful networking South Asias methodology and applies it to leverage the knowledge of African expatriates for African development, starting with Ghana.

http://www.awlae-eln.org/
Winrock International's website for African Women Leaders in Agriculture and the Environment's (AWLAE) Electronic Learning Website.

http://arpan.winrock.org/index.cfm
Website for the African Rural Policy Analysis Network. ARPAN is an interdisciplinary network of African social scientists that operates as a non-governmental organization whose focus is on agricultural and general rural development and policy analysis in African countries. The Network provides research grants of up to US$5,000 to African social scientists, organizes methodology and peer review workshops for grantees, and publishes and disseminates the results of funded studies. ARPAN has been supported by the Ford Foundation, USAID, and the USDA

http://www.usaid.gov/alnk/welcome.html
AfricaLink Website of USAID. AfricaLink is an activity of the division within USAID in Washington that supports regional networks of African policy makers and scientists in agriculture, natural resource management, and the environment. It focuses on the problems of access to ICTs by specific, organized networks. AfricaLink works in close collaboration with USAID bilateral and regional missions in Africa.

Other Applications and References

http://www1.worldbank.org/publicsector/egov/seoulcs.htm
http://www.fnfkorea.org/fnst_eng/localauto/changon1.htm
Discussion of the Online Procurement ENhancement (OPEN) system of public procurement in Seoul, South Korea. The online system has won international acclaim as a method to improve

transparency and reduce opportunities for corruption. Extension of similar systems to other municipalities offers one method of improving governance, even in rural areas.

http://www.fastcompany.com/fast50/people/socialentr/43.html
FastCompany Magazine's coverage of Microsoft's H.E.A.R.T. team, which helped develop a tracking system for the Red Cross to assist with registration and supply chain management for refugee situations, including the use of PDAs that synchronize with web-enabled systems for field workers. This model is adaptable for food security, famine, and other activities where supply chain management capacity is important.

http://usembassy.state.gov/posts/rp1/wwwhamon.html
US Embassy in Manilla's description of the Alliance for Mindanao Off-Grid Renewable Energy (AMORE) project funded by USAID in the Philippines. Not mentioned in this description is the use of electricity to power small PDA systems to help community project monitors evaluate use and provide technical assistance.

http://www.balancingact-africa.com/
Balancing act is an NGO centered on developing content and innovative ICT mechanisms to solve poverty and development challenges in Africa. Balancing act provides a valuable ICT-practices news service that covers African issues and best practices.